The Dissertation Committee for Madlene Patience Hamilton certifies that this is the approved version of the following dissertation:

Teacher Characteristics and Race/Ethnic and Economic Disparities in Academic Achievement at the Start of Elementary School

Committee:

_____
Pedro Reyes, Co-Supervisor

_____
Robert Crosnoe, Co-Supervisor

_____
Julian Heilig

_____
Jennifer Holme

_____
Aletha Huston

Teacher Characteristics and Race/Ethnic and Economic Disparities in Academic Achievement at the Start of Elementary School

by

Madlene Patience Hamilton, B.S.; M.A.

Dissertation

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Philosophy

The University of Texas at Austin

August 2009

Dedicated to my dearly departed aunt,

Mrs. Alberta Olufemi Parker.

Your spirit still lives with us. We miss you very much!

The dissertation was supported by Award Number F31HD055151 from the Eunice Kennedy Shriver National Institute of Child Health & Human Development. The content is solely the responsibility of the author and does not necessarily represent the official views of the Eunice Kennedy Shriver National Institute of Child Health & Human Development or the National Institutes of Health.

The pursuit of this degree has definitely been a labor of love and I thank my Lord and Savior Jesus Christ for the many blessings he bestowed on me at every step during this process. I also thank many of you who have sowed into my life during this journey. First, I would like to thank all of my colleagues whom I met and bonded with during this process. There are so many but in particular, Jennifer March Augustine, Carey Cooper, Kenya Haynes, Danielle Hayes, Shannon Stackhouse-Flores, John Gasko, Curtis Brewer, Juanita Chinn, Lisa Goodnow, Brandy Baker, and Karen Herbert.

Second, I am forever grateful to the great scholars who served as my mentors and dissertation committee advisors. Thank you to my dissertation co-chairs, Drs. Pedro Reyes and Robert Crosnoe. Dr. Reyes, I thank you for helping me keep my eyes on the finish product and stay focused on the purpose of this work. Dr. Crosnoe, I cannot praise you enough for taking me on as your student, walking me through seemingly difficult tasks and giving me your unending support these past four years. Your mentorship has been truly invaluable. Dr. Aletha Huston, your scholarship has helped shaped my professional outlook since I first walked into your research lab as an undergraduate student many years ago. I thank you for your candidness about the academic process and helping me understand how I can make a contribution. Dr. Julian Vasquez Heilig, thank you for taking some of the mystery out of what I will experience these next few years by

allowing me the opportunity to share in your walk as a new professor. Your support has not gone unnoticed. Dr. Jennifer Jellison Holme, thank you for your insight on some of the trivial issues I struggle with in my work. I truly appreciate the support and guidance I have received from each of you.

Dr. Angela Valenzuela, thank you for your friendship early on and the opportunity to experience your humanity. Dr. Jay Scribner, you have been my voice of reason through this process. When none of this made sense to me you always helped me separate the wheat from the chaff. Although you have retired and could reserve all of you time to sailing on that beautiful boat, you still made time to call me from Maine to check on my progress. I cannot thank you enough for your honesty, friendship and support over the years.

Third, I am grateful to my huge extended family of aunts, uncles, cousins, and grandparents who have supported me throughout my life. A special thank you to my lifelong friends who have cheered for me, laughed, listened and continue to live life with me. Sylvia, my loving sister, thank you for the wonderful energy and spirit you bring into my life. My father, Salako Hamilton, for your quiet reserve and easy spirit. I come from a long line of educators, or as they would like to be referred to as “career classroom teachers”. From my late grandmother, Patience Hamilton, and uncle Spurgeon Parker to my loving mother, Janet Parker. I could not have gotten to this point in my life without the legacy, expectations and examples set by my family. All of the valuable things I learned in the classroom only supplemented the profound lessons I was taught at home.

Finally, I cannot thank my mother enough for raising two wonderful daughters better than we could have ever hoped for and with more love than we can ever know

what to do with. You taught me early on the essence of Proverbs 18:15 "*the heart of the discerning acquires knowledge; the ears of the wise seek it out*." In my continued journey I will hold on to these principles. I cannot thank you enough for your support, your honesty, your optimistic outlook on life and for allowing me to explore this great world with limited boundaries. God Bless You!

Teacher Characteristics and Race/Ethnic and Economic Disparities in Academic Achievement at the Start of Elementary School

Madlene Patience Hamilton, Ph.D.
The University of Texas at Austin, 2009

Supervisors: Pedro Reyes and Robert Crosnoe

As an exploration of some of the major provisions of NCLB, this dissertation applies the resource substitution perspective (Mirowsky & Ross, 2003) to the early years of elementary school and examines various forms of teacher human capital (e.g., educational background, certification, experience) to capture the pool of potential compensatory resources for segments of the child population deemed at-risk for academic problems because of their race/ethnicity and/or economic status.

The research literature concerning teacher effects on academic performance and disparities in the elementary grades (vs. later levels of schooling) is limited, and the prevailing research on teacher effects in general either focuses on factors that are less relevant to early childhood education or provide mixed results. Applying multilevel modeling and other statistical techniques to data from the Early Childhood Longitudinal Study-Kindergarten Cohort, I found that poor and non-poor Black children are consistently the most at-risk groups in math between kindergarten and third grade and in reading by the end of third grade. Poor Black and poor Hispanic children appear to benefit more from teachers who have regular and/or elementary certification than their non-poor White peers. In general, Hispanic children tend to be more responsive to resources in the early grades than other at-risk groups.

Table of Contents

CHAPTER ONE:

INTRODUCTION

Racial and economic disparities in academic performance, which tend to widen as schooling progresses, have been the driving force of educational policy for some time. This long-standing tradition is particularly evident in the No Child Left Behind (NCLB) Act, which mandates that schools disaggregate achievement data by race/ethnicity and income status (Public Law 110) as a way of tracking the magnitude of disparities over time.

The purpose of this provision of NCLB, which I refer to as the at-risk population provision, is to give parents, educators, and tax-payers accountability information on how schools are performing. It is paired with other provisions that suggest, in very general terms, ways to address disparities, such as the highly qualified teacher provision that calls for improvements in teacher quality across schools. This policy, as with many other educational accountability policies, falls short of providing specific research-based strategies to reduce the academic problems of the children in groups viewed as at-risk. In particular, the research literature concerning teacher effects on academic performance in the elementary grades (vs. later levels of schooling) is limited, and the prevailing research on teacher effects in general either focus on factors that are less relevant to early childhood education or provide mixed results.

This dissertation explores the link between these two NCLB provisions—at-risk population, highly qualified teachers—in an effort to add to the social science research base informing education policy and, in the process, to offer guidance to schools working

under NCLB and similar state policies. Specifically, this dissertation addresses two major limitations of NCLB provisions and related research.

First, the at-risk population provision of the act orders achievement data to be disaggregated for racial minorities and poor students separately, despite ample evidence accumulated by educational researchers that these disparities overlap considerably (Alexander, Entwisle, & Olson, 2007; Rothstein, 2004). Assessing the magnitude of disparities related to race-poverty groupings rather than race/ethnicity and poverty, respectively, does more to identify critical targets for intervention.

Second, neither the at-risk population nor qualified teacher provisions consider the need to tailor approaches and strategies to specific stages of schooling and/or the particular developmental status of students. The early years of elementary school are likely to be important to understanding the link between teacher quality and achievement disparities. Ample evidence has documented that this stage is a time when achievement disparities are narrower and more reactive to social interventions than they are in later developmental stages. Thus, elementary school represents a period when educational investments may provide the greatest long-term returns (Alexander & Entwisle, 1988; Heckman, 2006; Pianta. & Walsh, 1996). One reason that the research on the impact of teacher effectiveness on academic disparities has yielded mixed results may be that the studies in this literature consistently focus on secondary schooling, when teacher effects have typically been assessed by subject matter proficiency and not by other factors that may be more critical to early education (Darling Hammond, 2000; Lasley, Siedentop, & Yinger, 2006).

In order to address these gaps in existing research, this dissertation applies a theoretical perspective that comes from health research but is relevant to thinking about educational disparities. According to the resource substitution perspective (Mirowsky & Ross, 2003), the impact of some protective resources are more pronounced in social and demographic groups that have less access to resources overall. Applying this perspective to the focus of this dissertation, the key question becomes: can school adults substitute for social and human capital traditionally demanded by American schools that are less abundant in the family and community contexts of children from historically disadvantaged groups? This dissertation applies the resource substitution perspective to the early years of elementary school and examines various forms of teacher human capital (e.g., educational background, certification, experience) to capture the pool of potential compensatory resources for at-risk children. Following this conceptual framework and its relevance to informing policy, the three research questions guiding this dissertation are:

1. What are the largest achievement disparities in core subjects during the primary grades of elementary school when race/ethnicity and economic status are considered in combination rather than separately?
2. To what extent do race-economic differences in aspects of teacher human capital explain the largest achievement disparities during these critical years?
3. To what extent does equal access to the same kinds of teachers reduce the largest achievement disparities during these critical years?

To answer these important questions, I identify eight groups of children in the nationally representative Early Childhood Longitudinal Study—Kindergarten Cohort (ECLS-K) by cross-classifying race/ethnicity (White, Black, Latino/a, Asian-American) with economic status (as defined by the federal poverty line) and then compare these groups on their initial math and reading test scores at the very start of kindergarten and on their ultimate test score gains by third grade. Multiple human capital characteristics of their teachers are used as potential mediators and moderators of these associations between race/ethnicity-economic status and achievement outcomes. Special care is taken to capture the impact of observable confounds (e.g., parent education, school location) and unobservable confounds (e.g., genetic traits, district policies) on causal inference by employing conventional multilevel multivariate modeling techniques with a class of post-hoc robustness indices. This dissertation, therefore, uses theory to connect different pieces of a major educational policy in order to shed light on specific actions that schools can take.

CHAPTER TWO:

REVIEW OF LITERATURE

In this chapter, I review past research and theory in three substantive areas: 1) academic achievement at the intersection of race/ethnicity and economic disadvantage; 2) teacher qualifications as a resource for improving achievement; and 3) the relevance of school entry as an effective intervention point for resource substitution. This review provides the background on which the basic objectives of this dissertation are based.

Population Level Disparities in Academic Achievement

NCLB has been the cornerstone of state-by-state elementary and secondary education policies since 2001. The act sets mandates that require states to closely monitor student achievement in the aggregate as well as by group level, defined by race/ethnicity, economic status, and disability status. With these criteria, schools can better identify the most at-risk segments of their student populations, with the logic being that additional resources will then be devoted to addressing any persistent lags in achievement in specific groups within the school. Although schools and school districts review the economic and race/ethnic disparities in isolation from one another, these two disparities overlap considerably. This overlap warrants further investigation. Below, I discuss each kind of disparity before explaining how they are intricately connected to each other.

Economic disparities in academic achievement. The American educational system was designed, in part, to equalize the life chances of children from different social classes (Mann, 1848). Nearly two centuries since the common school era, however,

socioeconomic stratification of the U.S. is still quite rigid, in large part because of what goes on in American schools (Lareau, 2004; Lucas, 1999).

Poverty provides a clear window into the social stratification of the U.S. A large share of American children live in families that meet the federal poverty threshold ($21,200 for a family of four in 2008), and their numbers are increasing. In 2007, the percentage of children living in poor families was 17.6% (12.8 million), which represented an increase from 16.9% (12.3 million) the previous year. Importantly, the poverty rate for children under six years of age (20.8%) was higher than the overall child poverty rate. Given the global economic crisis that began in late 2008, these numbers are likely to rise, at least in the short term.

From prior educational and demographic research, we know that children who grow up in impoverished households start school at a disadvantage compared to children from more affluent homes. We also know that because of this differential starting point, they eventually accumulate fewer educational credentials than their peers over their lifetimes (Corcoran, 2001). The academic struggles of poor children begin to show up as early as kindergarten and progressively increase as they matriculate through school. Poor children make lower grades, post lower test scores, and engage less in school than their more affluent peers (Duncan & Brooks-Gunn, 1997; Lee & Burkham, 2002; Mayer, 1997; Pianta, 1999; Rothstein, 2004). Of course, these poverty-related patterns are closely connected to other aspects of family background, such as race, family structure, and parent education, but the independent link between poverty and academic outcomes is well-documented (Alexander & Entwisle, 1988; Danziger, Sandefur, & Weinberg, 1994; Iceland, 2003). This pattern has been consistent over time, and moreover, is

growing stronger in all segments of the American population (Duncan, Huston & Weisner, 2007).

These persistent economic disparities in academic achievement and educational attainment are noteworthy for many reasons, not the least of which is that they help to reproduce economic stratification across generations. Doing well in school and gaining valued credentials boosts occupational attainment, promotes health, and stabilizes marriage and relationship patterns. These factors in turn, protect against poverty in the long-run and against the reproduction of poverty in the next generation (Kingston et al., 2003; Mirowsky & Ross, 2003; Pulliam & Van Patten, 1991).

This intergenerational transmission presents tough questions about why and how the ultimate life prospects of disadvantaged and advantaged youth are so starkly different, the way the education system plays into such disparities in life circumstance, and what to do about this problem (Duncan, Brooks Gunn, Yeung, & Smith, 1998). If the educational system contributes to this problem, it also presents an opportunity to combat it. Although prevailing research indicates that early and sustained quality education for poor children produces great returns on the child and population level (Heckman, 2008), the structures of schools and potential practices in the educational system serving large numbers of poor children typically do not fulfill this potential. For example, universal pre-school does not exist in many states, and the quality of instruction and service in high-poverty schools still trails low-poverty schools (Fuller, 2007; Barnett, Hustedt, Robin, & Schulman, 2004). This inequality in practice translates into disparities in outcomes.

Race/ethnic disparities in academic achievement. Differential achievement by race/ethnicity has long been a concern in the educational system. Typically, the focus is

on White and Asian-American children versus Black and Hispanic children. Although racial/ethnic achievement gaps narrowed in the 1970s and 1980s (Grismer & Flanagan, 1998), they now appear to be widening (Campbell, Hombo, & Mazzeo, 2000; Jencks & Phillips, 1998; Lee, 2002). For example, data from the National Assessment for Education Progress (NAEP) between the years of 1986 and 1999 showed that White students made twice the achievement gains of Black and Hispanic students (Lee, 2002). These trends in NAEP scores are indicative of the trends from early to late childhood and have implications for later performance.

Data from the Current Population Surveys of the U.S. Census Bureau shows that Black and Hispanic children demonstrate lower rates of academic progress than White and Asian-American children. Although all groups of children start school at about the same age, by ages 15-17, approximately 45% of Black and Hispanic youth are below the expected grade level for their age. These achievement gaps, which are rooted in historical processes such as legal and political conflict and institutional discrimination, have profound effects on educational outcomes and later opportunities for Black and Hispanic children. On average, Blacks with advanced degrees earn approximately $8,000 less than Hispanics (the second lowest earners) and nearly $16,000 less than Whites with the same level of education (Stoops, 2003).

When looking at contemporary race/ethnic disparities, two schools of thought are important: cultural and structural. Cultural arguments typically view race/ethnic disparities in education as rooted in the different family systems and community processes of various race/ethnic groups. The emphasis is on what is going on within these groups that is putting them at a disadvantage. A prominent example of this argument is Ogbu's

oppositional culture thesis (1983; 1987; 2003). According to this thesis, some minority groups have adapted to historical discrimination and disadvantage by inverting the educational incentive structure, equating it with Whiteness, viewing it as not serving them, and, as a result, reducing their academic effort. Although not exactly cultural, Hernstein and Murray's (1994) argument about the genetic components of race/ethnic disparities is often grouped with cultural perspectives. These cultural arguments are controversial, and they have received only mixed empirical support. Importantly, even if cultural factors do contribute to race/ethnic disparities in education, they are not amenable to external intervention. For example, the peer dynamics highlighted in the oppositional culture thesis, if true, would be difficult to change through large-scale policy interventions. Given the policy focus of this dissertation, I pay closer attention to structural factors that better lend themselves to policy outcomes.

Structural arguments typically view race/ethnic disparities as rooted in the way educational systems work and how they sort students into different opportunities to learn. They are concerned with school and classroom differences, such as teacher qualifications, classroom size, classroom management, and school funding, among many other things. Four decades ago, the Coleman Report described differences in school contexts by race. Likewise, *Savage Inequalities* strikingly revealed how White and minority students could attend vastly different schools even in the same school district (Kozol, 1991). More recently, studies by Fryer and Levitt (2004), Murnane,Willett, Bub, and McCartney (2006), and many others have pursued some of these structural questions using large-scale longitudinal data.

In their analysis of ECLS-K, Fryer and Levitt (2004) found that once they controlled for some important observable characteristics, such as parental education, family size and structure, whether the mother worked, and whether English is spoken in the home, the Black-White gap at school entry could be eliminated. As children progressed through third grade, however, this gap grew. Their findings suggests that schools contribute to the Black-White gap but that structural policies do not necessarily address the gap as students progress through the system. Challenging these findings, Murnane and colleagues (2006) used the NICHD Study of Early Child Care and Youth Development (SECCYD) to examine some of the same structural arguments put forth by previous researchers. These researchers reported that the Black-White gap at school entry does not go away, even after controlling for the same set of observable characteristics as the Fryer and Levitt study. They also reported that the gap in math narrowed but that the gap in English/Language Arts grew at a much slower rate during the first four years of schooling. This study suggests that school policies could be an effective way to improve instruction and learning. I expand on related research on the use of school resources as intervention tools shortly when discussing teacher characteristics.

Economic and race/ethnicity overlap. The economic differences discussed earlier intersect with the race/ethnic differences just described (Rothstein, 2004; Mayer, 1997; Condron & Roscigno, 2003; Roscigno & Ainsworth-Darnell, 1999). Asian-American and White children have lower overall poverty rates and higher academic achievement rates than Black and Hispanic children. According to the 2007 U.S. Census data, non-Hispanic Whites had a poverty rate of 8.2% and Asian-Americans had a poverty rate of 10.2%, whereas the poverty rate was 24.5% for Blacks and 20.6% for Hispanics. In most

studies of race/ethnic disparities, at least some of the disparity (and often almost all of it) is explained by such race/ethnic differences in socioeconomic factors (Fryer & Levitt, 2006; Entwisle, 2005; Lee and Burkham, 2002).

Yet, race/ethnic and economic disadvantages might do more than overlap. They might amplify each other. Indeed, for many Black and Hispanic children, poverty and race/ethnicity create a double disadvantage in the educational system (Borman, 2004; Crosnoe, 2005). Minority children who come from families with lower socioeconomic status are less likely to have access to the kinds of resources at home that schools traditionally demand, which, in turn, makes them less resilient in academic settings that put them at academic risk by way of discrimination, differential treatment, and unequal opportunity structures (Borman, 2004). Thus, the at-risk groups targeted by NCLB are not mutually exclusive. Consequently, viewing economic and race/ethnic statuses in *combination* rather than in *isolation* and disaggregating achievement data accordingly may be a better way to achieve the goals of this policy.

The first aim of this study, therefore, is to identify the largest achievement disparities in core subjects (e.g., math, reading) when race/ethnicity and economic status are considered in combination. Of course, I expect doubly disadvantaged groups to be worse off. What I want to know is the *full* picture of differences among groups as way of developing a sense of the range of risks to be addressed. Who is most at risk?

Teacher Characteristics and Child Achievement

In addition to stressing the need to understand the size and extent of achievement disparities, NCLB puts forward several strategies—albeit somewhat vague strategies—for addressing such disparities. One example is the highly qualified teacher (HQT)

provision, which is a hybrid of many locally driven state-constructed policies. This effort to address teacher quality suggests that the federal government views access to good teachers as a major factor in reducing race/ethnic and economic disparities. In contrast, the lack of solid guidance on how *specific* characteristics may reduce these disparities works against the grain of the overall goal. The U.S. Department of Education summarizes the focus of the HQT provision in four parts:

- Highly Qualified Teachers: To be deemed highly qualified, teachers must have: 1) a bachelor's degree, 2) full state certification or licensure, and 3) prove that they know each subject they teach.
- State Requirements: NCLB requires states to 1) measure the extent to which all students have highly qualified teachers, particularly minority and disadvantaged students, 2) adopt goals and plans to ensure all teachers are highly qualified and, 3) publicly report plans and progress in meeting teacher quality goals.
- Demonstration of Competency: Teachers (in middle and high school) must prove that they know the subject they teach with: 1) a major in the subject they teach, 2) credits equivalent to a major in the subject, 3) passage of a state-developed test, 4) HOUSSE (for current teachers only, see below), 5) an advanced certification from the state, or 6) a graduate degree.
- High, Objective, Uniform State Standard of Evaluation (HOUSSE): NCLB allows states to develop an additional way for current teachers to demonstrate subject-matter competency and meet highly qualified teacher requirements. Proof may consist of a combination of teaching experience, professional development, and knowledge in the subject garnered over time in the profession.

Thus, of the many aspects of teacher "quality" that could be highlighted, NLCB focuses primarily (although not exclusively) on the human capital characteristics of teachers—education, training, certification, professional development. Human capital is defined as investments in education and training to improve individual skills and capabilities (Coleman, 1988). Even though human capital is only one way of conceptualizing teacher quality, NCLB's emphasis on human capital is not surprising. In short, human capital characteristics have traditionally been viewed as more amenable to policy intervention than some teacher characteristics studied by social scientists (e.g.,

mastery of subject, pedagogical style) (Hanushek, 1971). One thing that is certain from any review of the relevant research is that the composition of the teaching staff of schools has long been viewed as central to issues of educational equality, and NCLB clearly follows that tradition.

In general, schools that serve poor and/or race/ethnic minority populations tend to have lower percentages of high quality teachers, generally defined in standard human capital terms (Clotfelter, Ladd, Vidgor & Wheeler, 2006; Lankford, Loeb & Wyckoff, 2002). These disparities have great consequences for students as they matriculate through school, but the nature of these consequences is more complex than commonly characterized. Specifically, if these students are disadvantaged by the quality of the teaching staff of their schools, then improving quality by increasing the number of certified and experienced teachers on the staff should blunt some of these disadvantages and improve achievement. The evidence for this contention, however, is mixed.

This dissertation wades into this debate. Working under the assumption that no single teacher human capital characteristic (e.g., certification, education, tenure) explains the majority of the variation in individual achievement or in achievement disparities and that individual student characteristics may greatly condition any teacher effects in developmentally specific ways, I look at the interplay between a broad set of teachers' human capital characteristics and demographic disparities in achievement over time.

Teacher education. Teacher education is often defined by degrees held, the level of coursework taken in a particular subject area, and the amount of professional development that the teacher has while on the job. Researchers have tested the effects of various measures of teacher education on student achievement, and the evidence is

inconsistent. For example, there is little consistent evidence supporting the contention that having a masters level degree or higher results in significant positive academic outcomes for children (Rivkin, Hanushek & Kain,1998).

Wenglinsky (2000) used the National Assessment of Educational Progress (NAEP) to measure inputs (education level and years of experience), classroom practices (e.g., use of small group instruction or hands on training), and professional development (training to support certain classroom practices). He found that one-third of teachers had at least a master's degree, three-fourths majored or minored in the subject they teach, and 60% had at least 10 years of experience. The least common topic for math professional development is dealing with special populations, such as English language learners and students with disabilities. Similar patterns are found for science and the coverage of topics dealing with laboratory skills. Of the teacher inputs, only having a major or minor in the subject taught is associated with improved student academic performance. Students whose teachers majored or minored in the subject they taught outperformed their peers by about 40% of a grade level in both math and science. Fergusson (1991) found that in grades one through seven, teachers with masters degrees accounted for some of the variation in achievement. This finding was not significant after the seventh grade.

Countering these findings, Ballou and Pudgursky (2000) and Hanushek (2003) lay out critiques of the teacher quality studies that show a positive or direct association between teacher characteristics and student achievement. Hanushek makes an economic argument by linking teacher compensation to student achievement and using the traditional measures of teacher characteristics, such as holding an advanced degree and experience, as proxies for teacher pay. Hanushek extends his argument to include

contextual school resources. His findings suggests that the association between teacher education and student outcomes is weak.

Teacher certification. Teacher certification has been instituted in many states as a standard practice to ensure that children receive proper instruction from teachers who are both academically and professionally prepared (Woellner, 1949). The debate for and against certification began in the early 1900's (Woellner, 1955). The current debate concerning the impact of having a full regular teacher certification is one that generates much disagreement. Moreover, the extant evidence can be used to support both sides of the debate. One argument is that fully certified teachers should undergo a more extensive preparation period and receive more training and practice in classroom pedagogy. The counter-argument is that the diversity of experiences of teachers who may come to the classroom in other ways enhances the educational process in a way that is otherwise lost in the traditional certification process.

Darling Hammond (2000, 2005) has shown that teacher certification is advantageous to student achievement. Her research indicates that "the percentage of teachers with full certification and a major in the field is a more powerful predictor of student achievement than the teachers' education level". She and colleagues have been engaged in an academic argument over this issue with several other scholars, including Goldhaber and Brewer (2000). This latter pair found that, although there are some positive effects of certification on students' achievement outcomes, this impact is not systematic. They also suggest that requiring certification for all teachers could have a reverse effect by restricting the pool of teacher talent. Ballou and Pudgursky (2000) have

also entered into this debate by suggesting that little rigorous evidence supports a link between teacher certification and student achievement.

These arguments center around some politically charged issues about the role of alternative certification in the hiring process. Setting these political arguments aside, the evidence still suggest some significant relevance of teacher certification on academic achievement, but the evidence may be less specific on the parameters in which these academic successes are evident.

Teacher experience. Teacher experience is arguably one of the most fundamentally contentious policy issues of this debate. A report from the National Center on Education Statistics (2000) notes that high-poverty schools and schools with the highest concentration of minority children have almost double the amount of inexperienced teachers (less than five years of experience) than low-poverty schools and schools with low concentrations of minority children. Studies also suggest that students learn more from more experienced teachers (Rivkin et al,1998, 2005; NCES, 2000).

This evidence suggests that teacher experience does matter, particularly when comparing new teachers with those who have at least five years of experience. Darling-Hammond (2000), found that these effects level off at about five years but that they do exist, especially when comparing experienced teachers to new teachers. Ferguson (1991) also found that teachers who had five or more years of experience produced students with higher test scores, among other academic markers of achievement.

Content knowledge. The most compelling evidence linking teacher quality to student performance concerns the association between deep content knowledge and increased student achievement (Darling-Hammond, 2000). The body of research on the

link between this teacher characteristic and achievement at the elementary school level is rather slim. Most studies citing deep knowledge in specific content area are conducted at the middle and high school levels—at which point the gaps between poor and non-poor and between Black/Hispanic students and White/ Asian-American students have been well-developed. One reason for this differential attention may be that primary or elementary school teachers are required to have general knowledge that is diffused across different subjects. Thus, measuring deep content knowledge during the elementary school grades and in multiple subject areas can be problematic because subject matter often overlaps and tap foundational blocks that build upon each other.

This special design of the elementary curriculum and teacher preparation practices is often overlooked (Lasley, Siedentop, & Yinger, 2006). There is, however, some consideration for this design feature in the research by Ferguson (1991). This work, in particular, is relevant to my dissertation because it teases out the racial and ethnic disparities associated with teacher quality and also looks at the entire school career. Ferguson's study, conducted in the 1980s in 900 Texas school districts, examined the relations with student achievement of teacher performance on the Texas Examination of Current Administrators and Teachers (TECAT, an exam that the state required all teachers who wanted recertification to take), class size, teacher experience, and teacher master's degree. The study found that the TECAT explained some of the variation in student averages at a given time point and predicted students' average scores over time. Worth noting is that the unit of analysis in this study was the school district and not the individual student.

Another reason that studying content knowledge is less prevalent in general than studying other teacher characteristics is that it is hard to measure. National data bases that collect extensive data on children and families, for example, rarely include tests of teacher knowledge. Moreover, directly affecting teacher knowledge through intervention is difficult. These problems likely contribute to the emphasis of NCLB on teachers' human capital characteristics, which may proxy, to some extent, content knowledge.

Evidence for lasting effects. Clotfelter, Ladd, Vigdor, and Wheeler (2006) studied the impact of teacher quality on math and reading achievement of fourth and fifth graders in North Carolina. Using a human capital-oriented measure of teacher quality that factored in years of experience, graduation from a competitive undergraduate institution, certification, and performance on certification exams, they found that children with lower quality teachers (so defined) performed on average .15 to .20 standard deviations lower than those with stronger teachers. The authors suggest that the effects in these primary years are cumulative over time and equate them to having a parent with low education, a finding that echoes the resource substitution idea underlying my dissertation (explained in detail shortly).

Furthermore, a crucial finding from the Ferguson (1991) study described earlier (1991) is that teachers in the primary grades can have enduring effects on eleventh graders' performance on the state standardized exam that is three times that of the effects of secondary school teachers. These claims of enduring, or time-lagged, teacher effects are based on teacher pass rates on the TECAT. What this suggests is that teacher quality is not only important but also that the foundation that is set in the early grades is critical to long-term achievement.

Following this, Nye, Konstantopoulos, and Hedges (2004) used the Stanford Achievement Test in a random assignment study of teacher effectiveness. They found that teacher effects are larger than school effects and that they are also much larger in low-SES schools. This suggests that poor and minority students who often comprise a large percentage of low-SES and low performing schools require, to a greater degree, effective or high quality teachers. An open question is whether they are indeed getting the qualified teachers.

On balance, then, markers of human capital development on the teacher level *may* be relevant to learning and skill development on the student level in the *early* years of the educational system. The link may be more pronounced for students from historically disadvantaged social and economic groups. Thus, investing in teacher quality may be a strategy, albeit not a foolproof one, for reducing economic and race/ethnic disparities in the American educational system. In this spirit, the HQT provision of NCLB evokes a cogent logic of using teachers as a resource to improve achievement for poor and race/ethnic minority children, even if its focus on human capital is somewhat narrow. This reasoning ties into the theory of resource substitution.

Resource Substitution

One way to investigate whether teachers matter during the transition into and through the early stages of formal schooling, is to apply the concept of resource substitution as a frame for analyzing the data. According to this theoretical perspective (Mirowsky & Ross, 2003), the impact of some protective resource are more pronounced in social and economic groups that have less access to resources overall (see the top half of Figure 1). In its most common application to health outcomes, the theory views

educational factors (e.g., years of educational attainment) as resources that make more of a difference in historically disadvantaged groups (e.g., poor minorities), substituting for their financial capital or lack of social status by giving them information and power to make better decisions about health behavior and health care. Educational resources, therefore, substitute for other resources. Two examples may be helpful for understanding the concept of resource substitution and how it relates to education.

[Figure 1 About Here]

The first example concerns the interaction of parent education and parental income and its potential impact on children. When mothers increase their education after having children, their children do better in school, most likely because returning to school themselves helps mothers be more proactive about managing their children's schooling and because schools are more receptive to their efforts. These benefits to children, however, are much stronger for low-income mothers. The potential benefits that might be accrued through returning to school are more redundant for women who have other socioeconomic resources, like more money and the social standing that comes with it (Magnuson, 2007).

Another example is the interaction of poverty and child care on child development. High quality child care has been shown to benefit the learning of children from all sectors of society, primarily by increasing the cognitive stimulation they experience before the start of formal schooling (NICHD ECCRN, 2005; Winsler, 2008). Yet, poor children get a greater boost from high quality child care than more affluent children. Again, some of the benefits of child care tend to be redundant with what can be found in socioeconomically advantaged families and communities, which tend to have

more abundant outlets and opportunities for stimulation and learning. In this case, resources available in high quality child care settings *substitute* for an imbalance of resources in other settings (Winsler, 2008).

In contrast to resource *substitution* is resource *amplification*, which suggests that children who already have resources in one context are better able to capitalize on additional resources in another context (see bottom half of Figure 1). As detailed in a comprehensive review of child interventions by Ceci and Papierno (2005), resource amplification can happen in interventions designed around the concept of resource substitution. In resource amplification, equal access to some resource across groups can actually result in a widening of disparities. As one striking example cited in the review, *Sesame Street*, which was created in part to reduce socioeconomic disparities in language and literacy disparities, is associated with cognitive gains for low-SES children who watch it. At the same time, viewing this program is associated with even bigger gains for high-SES children, most likely because what they learn is reinforced in multiple other contexts of their lives. Both groups improve, but the difference in their rates of improvement widens, rather than reduces existing disparities.

This contrast between resource substitution and resource amplification is obviously an important one to consider in any policy-oriented research, and I look into both possibilities in this dissertation. Prior evidence does seem to point more towards substitution than amplification. Specifically, when applied to the focus of this dissertation, resource substitution suggests that human capital in the school context can balance the lower levels of social and cultural capital (at least the kind valued by schools) and human capital in the family and community contexts of children from historically

disadvantaged groups. Scholars have made a distinction between dominant (Bourdieu, 1977) and non-dominant (Carter, 2003) social and cultural capital. Dominant social and cultural capital are often accepted and valued by the larger society and in formal settings, such as school and work. Poor and/or racial/ethnic minority children may be equipped with non-dominant forms of social and cultural capital that are less valued in a school setting and in turn may work against them academically. One example of this non-dominant capital comes in the form of dress. Some youth subscribe to an urban form of dress style that you would see in a hip-hop video. This image conjures up perceptions about who that individual may be and in turn, how they are treated by a classroom teacher. Whereas, a child dressed in a more preppy attire conveys a different perception. More importantly, the ability to access the forms of capital that enable an individual to succeed in certain settings is critical and determined by whether one has both the dominant and non-dominant forms of capital on which to draw (Carter, 2003; Laraeu, 1999).

The teacher qualifications targeted by NCLB are primarily human capital characteristics. At least some of the resources that can be derived from ties to an adult with human capital are redundant for students who have human and/or related kinds of social capital at home; for example, a child with socioeconomically advantaged parents or a White child who, by virtue of his/her race, is more likely to be tapped into larger social networks populated by more educated people (Rothstein 2008; Furstenberg, Cook, Eccles, Elder, & Sameroff, 1999). Such redundancy is less pronounced for poor minority youth, whose parents may have lower stocks of conventional human capital than the parents of non-poor White children and may also have lower levels of the kinds of social

capital (e.g., cultural value systems) that are prioritized or seen as legitimate by the personnel of American schools, who are typically White and middle class (Bourdieu, 1977). These poor minority children, in turn, may benefit more from having a particular teacher with the same amount of human capital as a non-poor White student's teacher.

The question of unequal/equal benefit from some resource is crucial from a policy perspective. If poor minority children do indeed benefit more from some school-based resource than their White, non-poor peers (resource substitution), then policy interventions would not have to equal out that resource across groups to reduce achievement disparities. Something less than equality would do. On the other hand, if poor minority children benefit less from some school-based resources than their White, non-poor peers (resource amplification), then policy interventions that equal out that resource across groups would not affect the magnitude of achievement disparities. Thus, establishing race/ethnic and economic differences in the prevalence of some school-based resource, such as teacher qualifications, must be followed by an attempt to establish the degree of *reactivity* to that resource within and across race/ethnic and economic groups.

The second and third aims of this dissertation, therefore, are: 1) to determine the extent to which differences in the education, training, and experience of children's elementary school teachers explain the largest race/ethnic and economic achievement disparities and then 2) to gauge the extent to which equal access to teachers with the same levels of human capital would reduce such disparities.

The Transition into School

In this chapter, I have made numerous references to issues of timing. Timing is important to understanding education and child development and to crafting effective

policy. Thus, that NCLB is largely agnostic to differences among stages of schooling is unfortunate. One argument of this dissertation is that the link between the two NCLB provisions highlighted here is strongest in early years of education.

According to Ramey and Ramey (1999), the transition to school is "an ongoing process that occurs during the first several years of life when children, families, and schools are making mutual adaptations to facilitate the eventual success of the child, family and school in the early elementary school years." Following the school transition model (Alexander & Entwisle, 1988) and contextual systems theory (Pianta & Walsh, 1996), early differences in achievement largely precede entry into elementary school. Thus, unlike academic differences in secondary school, the roots of these early differences lie in factors outside the educational system (although certainly they are often exacerbated by the educational system).

Based on this past research and theory (Pianta & Cox, 1999), differences in achievement among race/ethnic and economic groups should be smallest as students first start school and then grow as they progress to higher grades. Thus, focusing on reducing these initial disparities can help students move through the system on more equal footing. In other words, the best way to do something about race/ethnic and economic disparities in secondary school and higher education is to make sure children have equal opportunities years before they reach these stages.

Indeed, some evidence suggests that early investment in human and financial resources is the most cost-effective measure to improving the future skilled workforce (Knudsen & Heckman, 2006). Experimental studies, such as the part-day Perry Preschool program that targeted low income and low-IQ children in Michigan and the

full day Abecedarian program that targeted children with high scores on a risk index for developmental delays and school failure in North Carolina, have been instrumental in showing the long-term educational attainment benefits of early investments in schooling (Dickens, Sawhill & Trebbs, 2006; Heckman, 2006).

This general framework of higher returns to early action is echoed in more specific findings cited earlier in this chapter, which collectively suggest that teacher qualification effects fade or decay as children move through the system. Thus, in pursuing the aims of this dissertation, I focus on the first three years of elementary school. Disparities are likely smaller here than at later stages, but intervening during this period is likely to have a larger effect on equalizing opportunities for children from different groups before they have gotten too far along in the highly cumulative curricula of elementary and secondary school.

CHAPTER THREE:

METHODS

Data Source

Operated by the National Center for Educational Statistics (NCES), ECLS-K is a nationally representative sample of children who were enrolled in kindergarten in the 1998-1999 academic school year. This ongoing longitudinal study focuses on children's early school experiences and was designed to answer questions about education and educational inequality in ways that inform policy (see http://nces.ed.gov.ecls.kindergarten.asp for more details).

The first data collection occurred in the fall of 1998, when direct and indirect assessments of children were conducted and parents, teachers, and school administrators were surveyed. More data were collected in the spring of 1999 as most children finished kindergarten. In the fall of 1999, when the majority of children were in the first grade, data were collected from a sub-sample (30%) for special investigations of summer learning gaps and related issues. The full sample was again followed up with child assessments, parent interviews, and teacher/school administrator surveys in the spring of 2000, 2002 (third grade year) and 2004 (fifth grade year).

The methods of data collection varied. One-on-one assessments were conducted with the children at their school, with translations for English and Spanish. Children who needed either Braille or sign language or whose Individualized Education Plan indicated that they should not be assessed were excluded from the sample. Parent interviews lasting 45-50 minutes were conducted either by telephone or in person. They were translated in both English and Spanish, and those who were more comfortable speaking

in a language other than English or Spanish were given the option of having a translator, when available. Paper and pencil surveys were administered and used to gather data about teachers and schools.

The base-year child sample included 21,190 children. Of these, 11,741 were White, 3,762 were Hispanic, 3,210 were Black, and 1,364 were Asian-American. The total teacher sample consisted of 3,305 teachers, of whom 2,731 were White, 304 were Hispanic, 242 were Black, 90 were Asian-American, and 57 were American Indian or Alaskan Native. The total school sample included 866 schools. The average number of children sampled from each school during the base year was 23. Because of migration from year to year, approximately 25% of students switched schools from kindergarten to first grade and 50% switched schools at least once between kindergarten and third grade.

The analytical sample for this dissertation included approximately 14,887 children who participated in data collection up through third grade. Limiting the sample through attrition in this way could introduce bias because attrition from the sample was not random, but NCES calculated longitudinal sampling weights to account for this differential attrition. These sampling weights were employed in all analyses to maintain the representativeness of the sample and reduce the attrition bias. Moreover, as explained below, multiple imputation techniques were used for all item-level missing data so as to avoid the extreme bias related to listwise deletion. Worth noting is that ECLS-K does currently extend to fifth grade. Because of the focus on the early years of elementary school, specifically the primary grades, this dissertation did not examine the fifth grade data or the forthcoming eighth grade data.

Measures

Table 1 includes descriptive statistics (means/standard deviations for continuous variables, frequencies for binary variables) for all measures created for this dissertation.

[Table 1 About Here]

Academic achievement. The direct cognitive assessments in ECLS-K were adapted from commercial assessments and other NCES studies, including NAEP. The reading tests included items intended to gauge children's ability to, among other things, define words in context and evaluate passages of text. The math tests included items on conceptual knowledge, problem-solving, number properties, and measurement. Children took the first stage of the test and then, based on their performance, the low-, medium-, or high-difficulty stage. Item Response Theory allowed for the development of proficiency scores across test sequences so that scores could be compared from time point to time point and gains in test scores over time could be more accurately assessed.

This dissertation used IRT scores for reading and math from the fall of kindergarten, spring of first grade, and spring of third grade. These data were converted into two sets of change scores—gains in reading (or math) test scores between kindergarten and first grade and gains in reading (or math) test scores between first grade and third grade. More information on this modeling strategy is given shortly.

*Race/ethnicity and economic status***.** Parents reported the race/ethnicity of each child during the kindergarten data collection. For this dissertation, a set of dummy variables identifies children who were White, Black, Hispanic, Asian-American and Other. The Other category is a combination of all children who did not specify one of these four race/ethnic groups and, thus, were not used for analytical purposes. As for

economic status, I created an income-to-needs ratio for each family by dividing total income—mothers' reports of family income from all sources (including public assistance) at the start of kindergarten—by the federal poverty threshold from 1998 for the family's household size (which ranged from 2 to 17). Following convention across states in school lunch programs and NCLB accountability reporting, this income-to-needs scale is dichotomized at 1.85 to capture families below 185% of the federal poverty line for their household size. These families are designated as low-income, or poor. Finally, the set of race/ethnicity dummy variables have been cross-classified with the binary marker of poverty status to create an 8-category variable designating all possible combinations of race/ethnicity and economic status. See Table 2 for the distribution of this categorical variable.

[Table 2 About Here]

Teachers' human capital characteristics. All measures of teacher characteristics are replications of past ECLS-K studies (e.g., Palardy & Rumberger, 2008) and have been created for both kindergarten and first grade. Teachers reported their *highest degree earned*, with responses, ranging from 1 (high school diploma) to 7 (doctorate). I have recoded these responses into a binary variable (1 = masters degree or higher). Teachers were also asked about their *certification type* (0 = none, 1 = temporary/probational, 2 = alternative, 3 = regular, 4 = highest available), which allowed for the creation of a binary variable differentiating regular or higher-level certifications from all others. Reports of c*ertification in elementary education* (yes, no) serve as an additional binary certification variable. Two measures of *teacher tenure* assess how many years teachers had taught in the child's grade and at the study school. Lastly, teachers reported how many hours per

week they designated for paid preparation (1 = two or less, 2 = more than two but less than five, 3 = 5-9, 4 = 10-14, 5 = 15+). I use these teacher reports to measure *professional development*.

These human capital characteristics may co-occur with other teacher characteristics that could be related to child achievement and, therefore, need to be controlled. These teacher controls include teachers' age and race/ethnicity.

Although, in line with NCLB, this dissertation focuses on teachers' human capital characteristics, I look more closely at observed teacher effects to consider whether they operate through more classroom-based teacher practices. Following the work of Xue and Meisels (2004), I created two sets of classroom practice variables, one set for reading instruction and the other for math instruction. Teachers reported the frequency with which they taught specific math and reading skills in their classes (0 = never, 1 = once or month or less, 2 = 2-3 times a month, 3 = 1-2 times a week, 4 = 3-4 times a week, 5 = daily). Reading instructional characteristics focused on teachers' use of phonics and whole language instruction based on factor analysis (see Xue and Meisels 2004). Nine items were averaged to create the composite for phonics instruction, including questions on how often children were taught letter names, alphabet and letter recognition, and matching letters to sounds. Seventeen items were averaged to create the composite for whole language, including questions on how teachers taught vocabulary, teachers used cues for comprehension, and children observed printed text while the teacher read a story. Adapting the Xue and Meisels (2004) approach to math instruction, I created measures of measurement approaches (average of 10 items), spatial analyses (average of 5 items),

number operations (average of 5 items), comprehension (average of 5 items), and mechanics (average of 3 items).

Family controls. To account for the selection of children from different backgrounds into schools with varying degrees of teacher qualifications, analyses controls for a large set of family status factors. Parents reported their levels of educational attainment, with responses collapsed into five categories (1 = less than high school, 2 = high school graduation, 3 = some post-high school education, 4 = college graduate, 5 = post-graduate degree). The maximum level in the family measures parent education. Parents also reported the type of household in which the child currently lived, which I have used to create a binary measure of family structure (two biological/adoptive parents versus other family type). Mothers reported the average number of hours per week that they worked at their current employment during the kindergarten data collection, and I used these reports to create a set of dummy variables for full-time work, part-time work, unemployment, and absent. Immigration status is important to consider given the large variation in academic outcomes within all race/ethnic groups, but especially Hispanics and Asian-Americans, by generational status. Consequently, I have combined information from parent reports about birthplace into a single binary marker differentiating the children of immigrants (regardless of the children's own birthplace) from all other children.

Child controls. Several factors are important to control for because they capture the selection of children into schools or tap systematic differences in the circumstances in which children took standardized tests and, therefore, the level of learning they could demonstrate. In the first data collection, parents reported whether their children had

spent time regularly in non-parental child care in the year before they entered kindergarten and, if so, what type. I have consolidated this information into a set of dummy variables capturing pre-kindergarten child care: parental, relative, non-relative, preschool, center-based day care, Head Start, other. Children who spoke Spanish and did not meet the English proficiency threshold on the Oral Language Development Scale were permitted to take the math assessment in Spanish. Thus, a marker has been created to designate assessment language at each time point. These same children were excluded from taking reading assessments, but the missing data strategy described below addresses this problem. Furthermore, children took these tests over a span of several months. Thus, some children had more learning time in school before taking the test than others. To control for the possible bias, I have measured the length of time between when the first assessment was given during that data collection and when the child actually took the assessment. For similar reasons, age is controlled for with the continuous measure provided by NCES.

School controls. Because teachers are not randomly assigned to schools and because of the often extreme variation in setting and resources of schools serving students of different race/ethnic and economic backgrounds, all analyses control for a large number of conventional school controls based on data from the school administrator survey. School sector is a binary measure differentiating private from public elementary schools. NCES provides a quasi-continuous scale for school size: 1 = 0 – 149 students, 2 = 150 – 299, 3 =300 – 499, 4 = 500 – 749, 5 = 750 +. School region is measured by a set of dummy variables (Midwest, Northeast, South, West), as is school urbanicity (central city, city fringe/large town, and small town/rural). School minority representation within

the school was also controlled for based on the percent of minority students. Finally, I have aggregated the individual-level poverty measure to the school level by counting the frequency of students in each school sample who met the poverty threshold.

Plan of Analysis

The basic analytical plan has several steps. I illustrate each step with the example of math test score gains between kindergarten and first grade. The first goal of the study is to assess the degree of basic disparities in academic achievement when race/ethnicity and economic status are viewed in combination. The kindergarten-first grade math change score is regressed on the set of dummy variables representing the combined race/ethnic and economic statuses along with the kindergarten math test score. Including the initial test score as a covariate allows for the level of achievement from which the rate of change occurs (e.g., 1 point gain for an already high achiever vs. a 1 point gain for an initially low achiever) to be considered. I begin the analysis by estimating this basic model with White, non-poor children (the largest category) as the omitted reference category for the focal set of dummy variables. Results reveal which groups gain more or less than White, non-poor children on math tests between kindergarten and first grade.

The purpose of this first set of analyses is to establish a basic rank ordering of the combined race/ethnicity-economic categories for over-time learning gains. Thus, I re-estimate the model with each race/ethnicity-economic category as the omitted reference. Comparing results across modeling iterations allows for a full cataloging of all significant differences among the eight categories in the typology. Such information identifies which groups are *most* at risk for low learning gains in the first two years of school. The degree to which this rank ordering holds after including all of the family, child, and

school controls in the model is assessed. Special attention is paid to identifying the factors that most powerfully alter the initially observed rank ordering or reduce large differences among the race/ethnicity-economic categories of children.

These models are estimated in the mixed procedure, which is the SAS mechanism for multilevel modeling (Singer, 1998). Individual students serve as the first level and schools as the second level. By allowing the intercept of the outcome to be random and partitioning the variance into within- and between-school components, multilevel modeling provides the most accurate estimates of higher-order effects; in this case, the effects of school factors on kindergarten-first grade math change scores (Raudenbush & Bryk, 2002). The multilevel approach corrects the design effects of ECLS-K, which are related to the clustering of students in schools in the sampling frame. It can also easily incorporate the aforementioned longitudinal sampling weights, which need to be used to reduce attrition bias and maintain representativeness. A comprehensive report on ECLS-K by Denton and West (2002) provides a more complete description of the ECLS-K design effects and sampling weights.

In the second set of analyses, I investigate the resource substitution idea by taking the comprehensive multilevel model from the first stage of analysis (including all significant controls) and adding all of the teacher qualification variables as predictors of the kindergarten-first grade change score. Significance levels and effect sizes in this modeling step identify which teacher qualifications best predict over-time math test score gains. Examination of the coefficients for the race/ethnicity-economic categories before and after entering these teacher qualifications variables reveal the degree to which race/ethnic-economic disparities in early learning gains are explained (or mediated) by

corresponding differences in access to highly qualified teachers (as measured here). When mediation appears to be occurring, I follow the procedure of MacKinnon, Fairchild and Fritz (2007) to actually establish the mediational pathway(s). According to their protocol, mediation occurs when a third variable affects the association between two other variables (see Figure 2). In this study, we consider the impact of teachers' human capital characteristics on the sequence between the eight race/ethnicity-economic status variables and achievement gains in math and reading across the three time points.

[Figure 2 About Here]

Next, I interact each teacher qualification variable with the race/ethnicity-economic status dummy variables. Significant interactions are graphed to determine whether they indicate resource substitution—children in the most at-risk groups gaining more, in terms of achievement, from having highly qualified teachers, so that equal access to highly qualified teachers reduces group level achievement disparities.

This modeling plan is repeated for the kindergarten-first grade reading change scores and then for the first-third grade change scores in reading and math. The first-third grade models include first grade versions, when available, of all independent variables, including the initial first grade test score and teacher qualifications variables.

The use of change scores to capture achievement gains warrants more comment. Since the advent of NCLB accountability, measuring gains has been a growing interest in educational research, but such gains can be assessed in various ways. In addition to the change score strategy, lagged modeling, in which the prior version of the outcome is entered into the regression as a covariate (Allison, 1990), is an option. I have chosen the change score approach here because it is more accessible to a policy audience than the

other strategies. The interpretation of coefficients is straightforward. Yet, I also realize that replicating the focal results across different methodological approaches boosts confidence in my findings. Thus, I perform a sensitivity analysis, in which I apply the same basic analytical plan to lagged models and then report any substantial departures from my main models.

Dealing with Missing Data

As noted already, all item-level missing data (e.g., missing data on specific variables for children who participated in the larger data collection at that wave) are handled with multiple imputation techniques. This is a necessary step because any reduction in the sample, especially in the biased way of listwise deletion, can be an additivity violation (Frank & Min, 2007). In other words, reducing the representation of any one group in the sample may leave analyses open to the criticism that results would have been different if that group had its full, unbiased representation. As mentioned previously, weights are applied to the models to account for differential attrition from the sample over time.

Like many multiple imputation techniques, the Imputation and Variance Estimation Software (IVEware; see Raghunathan, Van Hoewyk, & Solenberger, 2001) uses information from all available data to estimate several complete data sets with plausible values. Unlike other techniques, IVEware allows both categorical and continuous variables to be estimated simultaneously in equally accurate ways. With IVEware, I generate five fully imputed data sets. Switching to SAS, I estimate all mixed models within each plausible sample, using the MIANALYZE procedure to average results across each of the imputed samples to produce a final set of parameter estimates

for the model. Multiple imputation has proven to be a superior, less biased strategy for dealing with missing data than mean/mode imputation, listwise deletion, or other conventional techniques that are now falling from favor, especially in policy-oriented research for which unbiased estimates are crucial (McCartney, Burchinal, & Bub, 2006; Allison, 2001).

Addressing Selection Problems

Most of the educational literature on school and teacher effects is rife with endogeneity problems. If some factor selects a child into a particular school or classroom setting and affects achievement, then models that do not take this factor into account may misattribute cause when they reveal a significant association between a characteristic of that educational setting and the child outcome. Dealing with such problems is a critical part of informing policy. Unfortunately, without experimental designs, which are difficult and expensive to implement, this problem can never be completely solved (Clotfelter, Ladd & Vigdor, 2007; Duncan, Magnuson, & Ludwig, 2004). Many educational studies, however, have taken steps to promote causal inferences based on statistical models.

Controlling for a large set of covariates is one common strategy, which I employ here. The limitation of this strategy is that it only addresses the potential impact on causal inference of confounds that are known and can be observed in the data. Some confounds cannot be easily observed. Genetic traits are the best example. Moreover, some confounds are simply unknown. Using longitudinal data is one useful tool for dealing with such unobservable confounds because comparing the achievement of children over time who have the same achievement level at some early time point at least

partially accounts for what selected them into that earlier achievement level (Glazerman, Levy, and Myers 2003). Again, I have employed this strategy here. Still, more can be done. A recent class of educational statistics—robustness indices—is providing some additional leverage in dealing with the problem of unobservable confounds. I draw on one such index in this dissertation.

The Impact Threshold for Confounding Variables, or ITCV (Frank, 2000), is a robustness index that quantifies how big some unobservable confound would have to be to alter the significance level of a focal association observed in a statistical model. The ITCV is easy to calculate by hand. The equation is: $r_{xy} - r^{\#}_{xy} / 1 - r^{\#}_{xy}$, where $r^{\#}_{xy} = t /$ SQRT$[(n - q - 1) + t^2]$, t is the critical t-value, n is the sample size, and q refers to the number of model parameters (excluding the intercept). This equation can be extended to models with multiple control variables. The value generated from this equation gauges how correlated the confound would have to be with both the predictor and the outcome—when these correlations are multiplied—to reduce the focal association in the model to non-significance.

For example, consider a model that produces a significant association between teacher education and child achievement and imagine that the ITCV for this association comes out as .14. That value would mean that some unknown confound (C) would have to be correlated with *both* teacher education *and* child achievement at such a level to generate a product of .14 when these two correlations are multiplied. In other words, C would have to be correlated with both the focal predictor and with the outcome at around .37. I then compare this information to all of the correlations between ECLS-K variables with teacher education on one hand and child achievement on the other as a way of

benchmarking what the likelihood would be that some confound out there, unknown and/or unmeasured, might be big enough to wash out the significant association between teacher education and child achievement if I could identify and measure that unknown and/or unmeasured confound. This process does not establish causality. It assesses the level of confidence to be had in causal inference.

Robustness indices, therefore, are calculated for any teacher qualification measure that significantly predicts the child test score outcomes. They are also calculated when a teacher qualification variable significantly moderates the association between race/ethnic-economic status and these outcomes.

Initial Modeling Estimates

Prior to conducting the analysis, I estimated several factors for each model. I computed the intraclass correlation (ICC) to estimate the total variance that can be explained by cluster membership within a school. The ICC in kindergarten was .22 for math, meaning that 22% of the variation in the kindergarten math scores was between students in different schools and 78% was between students in the same school. The ICC was .18 for kindergarten reading. The between-school variance in changes in test scores between kindergarten and first grade was 10% for math and 12% for reading. The corresponding values for first-third grade change scores was 14% for math and 13% for reading. Thus, there was much less between-school variation—the variation that can be explained by school factors—in change over time than in starting level.

In addition, I also assessed the utility of estimating three level models, given that students were nested in classrooms (e.g., teachers) that were nested in schools. This exploration did not suggest that a three-level modeling scheme (vs. the two-level scheme

described above) was necessary. In the first wave of data collection in the fall of kindergarten, for example, there was an average of only three teachers nested in each public schools and only 1.4 teachers nested in private schools (NCES Manual, 2000). This low degree of nesting poses little threat to accurately estimating standard estimates (Guilkey & Murphy, 1993).

CHAPTER FOUR:

RESULTS

The general goals of this study were to estimate the magnitude of overlapping race/ethnic and economic disparities in academic achievement at the start of elementary school and then to explore the policy-targeted teacher characteristics that explained and/or reduced such disparities during this critical period. The results described in this chapter help to elucidate these issues.

The Overlap of Race/Ethnicity and Economic Status

A key argument of this study is that children's race/ethnic and economic statuses cannot be so easily separated as NCLB implies when it asks for achievement data to be disaggregated by race/ethnicity and economic status separately, rather than together. To this end, I cross-classified race/ethnicity and economic status in ECLS-K to get a better sense of the demographic breakdown of the population.

Table 2 describes the eight focal race/ethnicity-economic status groups. In this sample, there are more poor Black and Hispanic children than non-poor Black and Hispanic children. The opposite is true for White and Asian-American children. For example, whereas the percentage of poor White children is around 14.1% and non-poor White children make up 43.2% of the sample, poor Black children make up 8.8% and non-poor Blacks make up 4.2% of the sample. A similar pattern follows for poor Hispanics (11%) and non-poor Hispanics (6.8%). These statistics suggest that any testing data disaggregated by economic status will have an unequal representation of race/ethnicities across economic groups (and vice versa). Thus, whether observed economic disparities represent race/ethnic disparities or the reverse is unknown. Also

unknown is whether the race/ethnicity and economic disparities can amplify each other when they overlap.

Race/Ethnic and Economic Disparities in Early Academic Achievement

Having given the basic distribution of children across race/ethnic and economic categories, I now assess rates of academic achievement in core subjects across this typology. In Table 3, I present the results from several models in which kindergarten math and reading test scores were regressed on the focal race/ethnicity and economic status variables, before (Model 1) and after (Model 2) controlling for a large set of individual, family, and school control variables. For the models presented in this table, non-poor White children served as the reference category. Thus, all race/ethnicity-economic status coefficients should be interpreted as the difference between the group in question and non-poor White children on the kindergarten achievement tests. As an additional step, I also re-estimated each model with each race/ethnicity-economic status category as the reference. Comparing results across each model allowed me to develop a rank ordering of the race/ethnicity-economic status groups in terms of their scores on the tests. The results of each of these modeling specifications are not presented in the tables, but I do discuss the final rank orderings that emerged from these additional analyses in the text below.

[Table 3 About Here]

Beginning with kindergarten math achievement, all groups, with the exception of non-poor Asian-American children, scored significantly lower than non-poor White children when no other child, family, or school factors were taken into account (Model 1 in Table 3). When all of these covariates were controlled (Model 2), all

race/ethnicity-economic status coefficients remained statistically significant with the exception of the poor and non-poor Asian-American groups. The overall magnitude of the disparities, however, was reduced. The largest kindergarten math disparity, relative to non-poor White children, was for poor Black children, who scored about 3 points lower on the math test (an effect size equaling 33% of a standard deviation on the kindergarten math test score distribution).

As for the overall rank ordering of groups on the kindergarten math test, derived from all pairwise comparisons across models with different reference categories for the race/ethnicity-economic status dummy variables, the 8 groups fell into the following ranks: 1) White non-poor, Asian-American non-poor; 2) Asian-American poor, White poor; 3) Hispanic non-poor; and 4) Hispanic poor, Black non-poor and Black poor. Groups in the same rank had average test scores that did not differ from each other. Groups in different ranks, however, differed significantly in their average test scores. Based on these rank orderings and the magnitude of the coefficients (and clear breaks in the order of coefficients), the groups that appear to be most at-risk in math at the start of elementary school are poor and non-poor Black and poor (and to a lesser extent non-poor) Hispanic children.

Turning to kindergarten reading achievement, the results were quite similar to those just described for math. When no other child, family, or school factors were taken into account (Model 1 in Table 3), all groups scored significantly lower in kindergarten reading than the non-poor White group. When all of these covariates were controlled (Model 2), all race/ethnicity-economic status coefficients remained statistically significant, with the exception of poor Asian-Americans. Again, the

overall magnitude of the race/ethnicity-economic statuses disparities was reduced. The largest kindergarten reading disparities, relative to non-poor White children, were for poor Hispanic children, who scored 2.60 points lower, and poor Black children, who scored 2.28 points lower on the reading test (approximately 27% of a standard deviation on the test distribution).

As for the overall rank ordering on the kindergarten reading test, the 8 groups fell into the following ranks: 1) Asian-American non-poor; 2) White non-poor; 3) Asian-American poor, White poor, Black non-poor; and 4) Hispanic non-poor, Black poor, and Hispanic poor. Based on these rank orderings and the magnitude of the coefficients for the dummy variables in the models, the groups that appear to be most at-risk in reading at the start of kindergarten are poor Black children and Hispanic children (regardless of economic status).

The achievement results presented so far give a sense of "inequalities at the starting gate", to borrow a term from Lee and Burkham (2002). For the most part, they demonstrate the degree to which children from various segments of the student population entered school with different levels of math and reading skill acquisition. Although such disparities in starting level underlie many disparities observed at later points of schooling, school-entry differences among child groups can and do change once formal schooling has begun. As a next step, therefore, I examined test score gains between kindergarten and first grade by regressing a kindergarten-first grade change score in each subject on the same sets of predictors.

Table 4 presents the results for math gains between kindergarten and first grade. When none of the child, family, and school controls were included in the model (Model

1), all race/ethnicity-economic status groups had significantly lower gains on the math test across grades than the non-poor White children, including the non-poor Asian-American children who had scored similarly to the White non-poor children on the kindergarten math test. When the full set of variables were included in Model 2, some of these differences, relative to non-poor White children, were eliminated. The disparities that persisted despite these controls included poor White (b = -1.38, p < .01), non-poor Hispanic (b = -1.16, p < .01), poor Black (b = -3.72, p < .001), and non-poor Black children (b = -3.27, p < .001). These coefficients, particularly those for poor and non-poor Black children, indicate that the gap between the non-poor White group and these children grew significantly between kindergarten and first grade. The biggest of these disparities (poor Black vs. non-poor White) had an effect size equal to 23% of a standard deviation in the kindergarten-first grade change score and equal to 41% of a standard deviation in the kindergarten math test score.

[Table 4 About Here]

In terms of math test score gains between kindergarten and first grade, the basic rank ordering of the race/ethnicity-economic status groups was as follows: 1) Hispanic poor; 2) White non-poor; 3) Hispanic non-poor, White poor; 4) Asian-American poor, Asian-American non-poor; and 5) Black non-poor and Black poor. Thus, poor Hispanic children gained more on the test during this period, even though this greater rate of gain did not allow them to catch up to the top performing groups (it just narrowed the gap). The poor and non-poor Black groups appeared to be the most at-risk during this time point.

Table 5 presents the results for reading. The significant disparities in test score gains, relative to non-poor White children, were less numerous for this subject. Before (Model 1) and after (Model 2) controlling for the full set of child, family, and school covariates, non-poor White children posted significantly larger gains on the reading test over time than poor White (b = -0.90, p < .01), poor Black (b = -2.29, p < .001), poor Hispanic (b = -2.59, p < .001), non-poor Black (b = -.88, p <.01) and non-poor Hispanic (b = -2.09, p <.001) children. Any differences in reading test score gains between White non-poor children and Asian-American children (poor or not) were not statistically significant.

[Table 5 About Here]

The final rank ordering of race/ethnicity-economic status groups in terms of reading test score gains was: 1) Asian-American non-poor, White non-poor; 2) Asian-American poor; 3) White poor; 4) Black non-poor; and 5) Hispanic non-poor, Hispanic poor, and Black poor. The most at-risk groups were economically disadvantaged White and poor and non-poor Hispanic, and Black children.

To expand the window even wider, I next examined test score gains between the spring of first grade and the end of the primary grades of elementary school (the spring of third grade). The models in Tables 6 and 7 had the first-third grade change score (for each subject) as the outcome.

[Table 6 About Here]

Table 6 presents the results for math between first and third grade. When none of the child, family, and school controls were included in the model (Model 1), three of the race/ethnicity-economic status groups had significantly lower gains on the math

test across grades than the non-poor White children, poor White and poor and non-poor Black children. When the full set of child, family, and school control variables were added in Model 2, this same pattern held, relative to non-poor White children. The disparities (vs. non-poor Whites) that persisted despite these controls were for poor White (b = -1.02, p < .01), poor Black (b = -4.58, p < .001), and non-poor Black (b = -2.36, p < .001) children.

These coefficients were still quite large, particularly for Black children. For example, the largest of these disparities (Black poor vs. White non-poor) equaled 39% of a standard deviation in the first-third grade change score. These results indicate that the gap not only *persisted* between the White non-poor group and the Black groups but that the inequalities *grew* as students progressed through school.

[Table 7 About Here]

In terms of math test score gains between first and third grade, the basic rank ordering of the race/ethnicity-economic status groups was: 1) Asian-American non-poor, Hispanic non-poor and White non-poor; 2) Hispanic poor, Asian-American poor, White poor; and 3) Black non-poor and Black poor. The Black children (regardless of economic status) were again the most at-risk between first and third grade.

Table 7 presents the results for reading gains between first and third grade. Before (Model 1) and after (Model 2) controlling for the full set of child, family, and school covariates, non-poor White children posted significantly larger gains on the reading test over time than poor White (b = -1.51, p < .01), poor Black (b = -4.42, p < .001), poor Hispanic (b = -2.12, p < .01), non-poor Black (b = -4.51, p < .001) and non-poor Asian-American (b = -2.35, p < .01). Any apparent differences in reading test

score gains between non-poor White children and poor Asian-American and non-poor Hispanic children were not statistically significant. The final rank ordering of the race/ethnicity-economic status groups in terms of reading test score gains during this period was: 1) White non-poor, Hispanic non-poor; 2) White poor, Hispanic poor; 3) Asian-American poor, Asian-American non-poor; and 4) Black poor, and Black non-poor. Thus, the gains of Asian-American children (regardless of economic status) began to slow as they moved to the end of the primary grades, and Black children (poor or non-poor) appeared to be the most at risk by this point.

Putting together all of this information on race/ethnicity and economic disparities in math and reading achievement in the primary grades, poor and non-poor Black children appeared to be consistently most at-risk (relative to other groups) in math from kindergarten through third grade. Whereas poor Hispanic children appeared to be at risk in kindergarten, they made significant gains between kindergarten and first grade that persisted through third grade. The reading results were far less consistent. In kindergarten, poor and non-poor Hispanic and poor Black children were most at-risk. By first grade, poverty was what mattered most, cutting across race/ethnic lines. By third grade, poor and non-poor Black children were the groups most at-risk (at least when defining risk in terms of relative standing).

The disparities for Hispanic children (relative to other child groups) showed up in kindergarten in reading, but they eventually made significant gains by third grade that helped them make up some of the gap. They appeared to benefit from the start of formal schooling, allowing them to close a gap that predated school. The initial disparities could possibly be attributed to low language proficiency.

The group that consistently appeared to be at-risk in both math and reading at each time point was Black children, especially those who were poor. Economic status certainly matters for the lower positions of Black children on the test score distribution, but it is not the only factor. Something about race, perhaps differential treatment based on race, is contributing to these disparities. .

Focusing on Teachers

Having established the basic levels of disparities in early math and reading achievement by race/ethnicity and economic status, I turned to the next goal of this dissertation, which was to explore the potentially multi-faceted role of teachers' human capital characteristics in these overlapping disparities. In doing so, I was especially interested in the race/ethnicity-economic status groups that appeared to be the most at risk at each stage of early schooling.

As a first step, I review the basic characteristics of teachers in ECLS-K. Referring back to Table 1, first and third grade teachers had slightly more education than kindergarten teachers. Over 75% of teachers in all three grades had regular certification, and over 85% were certified in elementary education. The average length of time a teacher taught in their respective grades ranged between seven and nine years. The average length of time teachers taught in a school was about nine years. As for a non-human capital factor that was still important in the context of this dissertation, slightly over 80% of the kindergartner teachers were White (this information only collected in the first year of data collection).

Recall that I was interested in two ways that the kinds of teacher characteristics targeted by NCLB and other educational policies may be related to achievement in

general and race/ethnic and economic disparities in achievement in particular: mediation (disparities in teacher characteristics explain corresponding disparities in achievement) and moderation (disparities in achievement fluctuate in magnitude and direction according to exposure to different kinds of teachers).

Exploring either the mediating or moderating role of teacher characteristics was not advisable when looking at kindergarten disparities because of the lack of exposure that kindergarten students had overall to their teachers when they took the first test. Thus, all teacher-focused analyses were conducted for the models with the kindergarten-first grade and first-third grade change scores as outcomes. Mediation was assessed following the steps laid out by McKinnon and colleagues. Briefly, if the magnitude of the coefficients are substantially reduced once the mediating variable is added to model, then mediation is said to occur.

In Model 3 of Tables 4 and 5, I added the full set of teacher human capital characteristics (plus the teacher control variables) as predictors of the outcomes. For kindergarten-first grade math, having a teacher with elementary certification appeared to partially mediate the associations between the outcome and being a poor and non-poor Black, non-poor Hispanic, and poor White child. Basically, the previously observed coefficients for these groups were attenuated when the elementary certification variable was added to the model (compare the coefficients in Model 2 to the corresponding coefficients in Model 3). This attenuation was so small, however, that any mediation by elementary certification could not have been strong or even meaningful. Turning to the kindergarten-first grade reading change score, no teacher characteristics significantly predicted the outcome (see Model 3 in Table 5).

Adding the first grade teacher characteristics (and teacher controls) to the models for first-third grade test score changes revealed no significant predictors of the outcomes and, therefore, no mediation of race/ethnicity-economic disparities by teacher human capital characteristics. This finding (or lack of a finding) suggests that differences in test score gains between first and third grade were not a function of having teachers with different human capital characteristics, at least as captured by these standard measures.

Thus, one teacher characteristic appeared to be related to test score gains early in the primary gains, and it may have played a small role in linking race/ethnicity-economic status to these gains. That characteristic was elementary certification. The degree to which these findings support causal inference is still open for debate. Although the models described above controlled for a large set of child, family, and school controls, these controls only included factors that were theoretically identifiable and that could be measured in ECLS-K. Other factors—either unknown, unmeasurable in ECLS-K, or both—could be confounded with these observed teacher effects. To gauge the robustness of the teacher characteristic that looked to be mediating the focal disparities, I calculated the ITCV for the elementary certification coefficient in each model in which it was significant. The ITVC scores for elementary certification were quite low (e.g., less than .01). A low ITCV suggests that the observed effect of the elementary certification variable would be vulnerable to controls for other heretofore uncontrolled factors.

In sum, differences in teachers' human capital characteristics did not appear to mediate race/ethnic and economic status disparities in achievement in the primary grades. As such, I do not pursue the ancillary analyses I had planned (mentioned in Chapter 3)—examining whether associations between the important teacher human capital

characteristics and achievement gains, across groups, were themselves mediated by teachers' instructional practices in the classroom.

Teachers as Potential Protective Factors

Turning to the moderation issue, the next modeling steps were intended to assess the extent to which equal exposure to the same kinds of teachers might reduce achievement disparities during the early years of elementary school. Each of the four main models (kindergarten-first grade and first-third grade in each subject) was extended to include interactions between the race/ethnicity-economic status dummy variables and each of the focal teacher characteristics. Each set of interactions (e.g. the interactions for each focal teacher characteristic) were modeled separately from each other, although all modeling iterations controlled for the full set of child, family, and school factors. Across models, the norm was for the interactions to be non-significant. When significant interactions were detected, I calculated predicted change scores based on the model results—varying high and low values for the teacher variable for each race/ethnicity-economic status group, holding all other variables to their sample means—to interpret what the interactions represented and to assess whether the effect sizes captured by the interactions were meaningful.

Table 8 presents the results of these interactions for math test score gains between kindergarten and first grade. Teacher certification type significantly interacted with the marker for poor Black children ($b = 2.48$, $p < .05$). Elementary certification significantly interacted with the marker for poor Hispanic children ($b = 3.52$, $p < .01$). Teacher school tenure significantly interacted with the marker for the non-poor Black children ($b = .17$, $p < .05$). Paid professional development for teachers significantly interacted with the

markers for poor Black children (b = 1.59, p <.01) and non-poor Hispanic children (b = -1.02, p < .05).

[Table 8 About Here]

Calculating the predicted change scores revealed that the certification and grade tenure interactions were all in the direction of resource substitution. Poor White and Hispanic children and Black non-poor children benefited more from having a teacher with elementary certification than did non-poor White children (see Figure 3). For example, the difference between children who had a certified and non-certified teacher was 0.14 points for non-poor White children but 3.66 points for poor Hispanic children. These findings suggests that teacher resources, such as being certified in elementary education, can potentially help reduce the inequalities between poor White and Hispanic and non-poor Black children and non-poor White children. Recall that previously I reported a low ITCV for elementary certification and kindergarten-first grade math. On closer inspection, this low ITCV was driven by the small (almost 0) correlation between certification and the math change score for non-poor White children, by far the largest portion of the sample. This correlation, however, was stronger for other groups of children, particularly poor White and Hispanic children and non-poor Black children (the very groups captured in these significant interactions). For them, elementary certification had a robust effect.

[Figure 2 About Here]

Poor Black children also benefitted more than non-poor White children from being in classrooms with teachers who had a regular teaching certificate. This example of resource substitution also led to a reduction in the size of this disparity. The other

interactions in the Table 3 were more in line with resource amplification. When a teacher human capital characteristic was associated with greater math gains between kindergarten and first grade, this association was stronger for White non-poor children than for the comparison group.

The results of the interaction models for kindergarten-first grade reading gains are presented in Table 9. Elementary certification significantly interacted with the marker for poor Hispanic ($b = 5.33$, $p < .01$). Teacher education significantly interacted with the marker for poor Hispanic ($b = 1.50$, $p < .01$) and non-poor Hispanic ($b = -2.00$, $p < .05$). Finally paid professional development significantly interacted with the markers for poor Black ($b = -1.46$, $p < .05$) and poor Hispanic ($b = 1.62$, $p < .01$). For the most part, these interactions all represented resource substitution, with the most at-risk groups generally benefitting more from the teacher human capital characteristics (in terms of greater kindergarten-first grade reading gains) than non-poor White children. For example, Figure 4 presents the predicted change scores based on the elementary certification interactions. For non-poor White children, there was no difference in test score gains between those with and without a certified teacher. For poor Hispanic children, however, those with a certified teacher had greater gains than those who did not. This difference was 4.34 points for Hispanic children, representing 27% of a standard deviation in the kindergarten-first grade change score.

[Table 9 About Here]

[Figure 4 About Here]

There appears to be a resource substitution teacher education effect for poor Hispanic children and a reverse teacher education effect for non-poor Hispanic children.

There also appears to be a reverse effect of professional development for poor Black children and a resource substitution effect for poor Hispanic children. More exploration is needed to understand these patterns, but they could reflect selection. For example, schools with high numbers of at-risk children may require teachers to take more professional development, thereby explaining some of the differences observed between the poor Black children and non-poor White children. Yet, at the same time, poor Hispanic children demonstrated a resource substitution pattern for teacher education. Clearly, this is a complicated issue that deserves a much closer look.

As for first-third grade gains in math (Table 10), teacher certification significantly interacted with the markers for poor White ($b = 1.38$, $p < .05$), poor Black ($b = 1.89$, $p < .01$), poor Hispanic ($b = 1.52$, $p < .05$) and non-poor Asian ($b = 4.07$, $p < .01$) children. Graphing these significant interaction effects revealed that poor Black children with certified teachers had bigger test score gains than poor Black children without a certified teacher, The same pattern was true for poor Hispanic and non-poor Asian but not for non-poor White children. This pattern is consistent with resource substitution (Figure 5). The observed benefits of certification ranged from a difference of .82 points (7% standard deviation in the first-third grade math change score) between those with and without a certified teacher for poor White children to 1.23 points (11% standard deviation) for poor Black children.

[Table 10 About Here]

[Figure 5 About Here]

Finally, for first-third grade gains in reading test scores (see Table 11), teacher certification type was significantly interacted with the markers for several race/ethnicity-

economic status groups: poor White (b = 1.98, p < .05), poor Black (b = 2.46, p < .01), poor Hispanic (b = 3.02, p < .01), and non-poor Black (b = 3.66, p < .01) children. As seen in Figure 6, having a teacher with regular teacher certification was associated with reading gains for poor and non-poor Black children, poor Hispanic children, and poor White children. For non-poor White children, however, having such a teacher was associated with smaller gains. A slightly reverse pattern, resource amplification, extended to the significant interactions between teacher tenure in grade with poor Black (b = -0.06, p < .01), poor Hispanic (b = -0.06, p < .01), poor Black (b = -0.10, p < .01) and non-poor Hispanic (b = -0.06, p < .05). A similar reverse pattern occurred between school tenure and poor Black children (b = -.11, p < .05).

[Table 11 About Here]

[Figure 6 About Here]

In sum, teacher human capital characteristics did not typically moderate links between race/ethnicity-economic status and test score gains in the primary grades. When they did, this moderation typically occurred for disparities involving most at-risk groups, usually (but not always) in the direction of resource substitution. Disparities for two of the most at-risk groups were consistently moderated by teacher characteristics between kindergarten and third grade. The disparity that was consistently moderated by teacher human capital characteristics involved poor Hispanic children. Disparities in achievement gains for this group (vs. non-poor Whites) were moderated by several teacher human capital characteristics, including certification type, elementary certification, teacher education and professional development. These patterns suggest that teacher human capital characteristics can serve as a protective factor for poor

Hispanic children who enter school with limited academic capital. Poor Black children also demonstrated similar moderating effects from teacher human capital characteristics, although not to the degree of poor Hispanic children. Whereas poor Hispanic children appeared to benefit from several teacher characteristics, poor Black children consistently appeared to benefit from only having a teacher with regular certification.

Overall, teacher certification type was a significant moderator at each time point and for each subject type except kindergarten to first grade reading gains. Although certification type was not a significant moderator during the last time point, having an elementary certification was a significant moderator for one of the at-risk groups. In sum, the resource substitution idea does apply, at least in limited terms, to the connection between teacher human capital characteristics and key race/ethnic-economic status disparities. I expand more on the possible meaning of these effects in a broader education policy context in Chapter 5.

CHAPTER FIVE:

DISCUSSION

The purpose of this dissertation was identify the most at-risk child groups during the first three years of schooling and assess the potential for investments in the human capital of teachers to reduce such academic disparities in this critical period of schooling. I did so by pursuing three specific aims. The first aim was to assess the magnitude of disparities in academic achievement when race/ethnicity and economic status were viewed in combination rather than separately. The second was to determine the extent to which differences in the education, training, and experience of children's elementary school teachers, factors which I refer to as teacher human capital characteristics, explained the largest race/ethnic and economic achievement disparities. The third was to gauge the extent to which equal access to teachers with the same levels of human capital would reduce such disparities. The approach I followed to investigate these aims was grounded in the theoretical underpinnings of relevant research literatures (transition to schooling, resource substitution) and key provisions of education policies such as the No Child Left Behind Act (the teacher quality and at-risk population provisions). The findings of this dissertation yield both support for these theoretical perspectives and, perhaps, some guidance to policymakers who struggle with finding ways to do something about academic disparities.

Importance of Race, Ethnicity and Economics in Academic Achievement

Social and educational researchers consistently target approaches used in school or community contexts to better understand the degree and variation in achievement disparities between the most at-risk children and the most advantaged children in society.

In the U.S., these disparities often fall along the lines of race/ethnicity and economic disadvantage. This dissertation took a slightly different approach by *cross-classifying* race/ethnicity with economic status rather than by looking at one while controlling for the other. We know from prior research that poor children of all race/ethnicities and minority children of all economic statuses are typically most academically at-risk (with risk defined in terms of relative standing on achievement tests and other academic indicators) throughout their school careers. What is perhaps more informative is how these two kinds of disadvantage work in conjunction with each other. Combining them allowed me to think about children in terms of gradations between who is most advantaged and who is most at-risk. More specifically, I could look into which of these probabilistically and relatively at-risk groups are *most* at-risk, whether they maintain their relative positions in the hierarchy or risk over time, and whether their positions were reactive to fluctuations in teachers' human capital resources.

Following prior work on the doubly disadvantaged in school (Borman, 2004; Crosnoe, 2005), I expected economically disadvantaged Black and Hispanic children to post lower levels of achievement than White and Asian-American children in the early grades of elementary school. As expected, poor and non-poor White and Asian-American children out-performed the poor and non-poor Black and Hispanic children from the ECLS-K in kindergarten. Yet, the overall patterns of disparities were much more complicated than this first look suggested.

In math, poor and non-poor Black children were the lowest performers and made the least gains between kindergarten and first grade and between first grade and third grade. Recall that in Chapter 2 I reviewed the well-known Fryer and Levitt (2004) study,

which found that Black children lose ground between school entry and third grade, net of a host of family, school, and individual characteristics. This dissertation confirmed that finding in a different way, by demonstrating that non-poor Black children (not just poor Black children) are academically at risk compared to non-Black children, even those who are poor. This trend held over time, which suggests that being Black (regardless of economic status) is a critical factor for policy intervention in the early years of education.

Another group that warranted concern included poor Hispanic children. Unlike Black children, the combination of race/ethnicity and economic status mattered in the Hispanic population; in other words, non-poor Hispanic children did significantly better than poor Hispanic children. Indeed, the latter group of children posted low levels of math test performance at the start of kindergarten. In contrast to poor and non-poor Black children in math, however, they made significant gains between kindergarten and third grade that reduced, but did not close, the math achievement gap with the more advantaged non-poor White children. Thus, math interventions targeting Hispanic children would be served by focusing on the very start of elementary school and by looking at the most economically disadvantaged children within this large (and growing) segment of the student population.

Turning to reading, combined race/ethnicity-economic disparities were pronounced at the start of school through first grade, and then race/ethnicity disparities were pronounced by the end of third grade. At the start of kindergarten, the groups that ranked at the bottom of the performance hierarchy were poor and/or Hispanic. Thus, non-poor Hispanic children appeared to be at-risk in reading if not in math. One explanation for this difference is that these children could come from homes that are

primarily Spanish speaking. Although I controlled for whether the child took the math test in Spanish, there may be some lingering language issues that go undetected and emerge at the start of school. Math may also be a subject that transcends language barriers more than reading.

The analysis of kindergarten to first grade reading gains revealed growing disparities between poor and non-poor children, with most of the poor groups (poor Black, White, and Hispanic) ranking at the bottom of the distribution. This finding was consistent with what we know about poverty and achievement. Poor children have lower achievement when compared to more economically advantaged children. Gains made between first and third grades, however, again emphasized race/ethnicity. Poor and non-poor Black children ranked lower on the testing gains distribution than all other groups during this period. Whereas the at-risk groups in math were fairly consistent over time, the at-risk groups for reading changed considerably for each time frame. Moreover, an early at-risk group, poor Hispanic children, made gains to close in on the achievement of non-poor White children by third grade. Schools may be more resourced to make necessary changes needed to address language issues early on when children are young. Spanish-speaking Hispanic children may also progress academically as language issues become more of a secondary problem. On balance, looking across all models, poor and non-poor Black and poor Hispanic children warrant additional investments beginning at the start of kindergarten.

Relying on Teachers to Reduce the Achievement Gap

In addition to emphasizing the need to track race/ethnic and economic disparities in academic achievement, NCLB also points to the stock of human capital among

teachers as a means of reducing disparities. The research on whether teachers actually make a difference in achievement and whether having teachers with more human capital can potentially reduce the disparities between the most at-risk children and the most advantaged is mixed, although I have argued that the inconsistency in this literature may be due to a lack of attention to the earliest stages of education. Accordingly, I hypothesized that human capital characteristics deserve a closer look in relation to early achievement disparities.

In ECLS-K, a large set of teacher human capital characteristics did not mediate the links between race/ethnicity-economic status and achievement in the primary grades. In other words, group differences in teacher human capital did not seem to produce group differences in achievement. One teacher characteristic, elementary certification, was a significant predictor for math gains between kindergarten and first grade. It did not appear to be robust to threats to causal inference in the full sample. No other teacher characteristic was significant for either subject between first and third grade.

Reviewing a host or studies supporting the use of teacher human capital characteristics as a tool for reducing disparities (Clotfelter, Ladd, Vigdor, and Wheeler, 2006; Ferguson, 1991; Darling-Hammond, 2000;), these results suggest that teachers do not matter. Yet, that is unlikely to be true. Teachers probably matter but not in the way we assume their value. Their impact may not be proxied by clear-cut tangible markers of human capital development, such as having a degree, but instead in what they do day in and day out in the classroom. This latter dimension of teacher characteristics, of course, is much harder to target through policy. Moreover, the frame in which teacher characteristics are studied may not be the best way to examine links between children and

achievement outcomes. Perhaps teacher characteristics should be less narrowly defined as simply reducing achievement disparities at a particular time point. The *cumulative* impact of having teachers with these human capital characteristics, year after year, may be more important than what we can see in most large-scale data sets. The research in this area is so extensive that we can be almost certain that the effects of teachers with these human capital characteristics on child learning are positive, but the manner in which we study these effects may limit how we can interpret the findings.

Turning from mediation to moderation (both of which are statistical as well as conceptual terms), I looked into whether equal access to teachers with the same levels of human capital may be associated with reduced achievement disparities between the most and least at-risk groups of children early in elementary school. What I wanted to find out with these analyses was whether teachers can serve as a protective factor or a buffer for the most at-risk children, which would either support or undermine calls for human capital investments in teachers as a means of reducing achievement disparities (as in NCLB). The findings offered some limited evidence for theoretical underpinnings of the resource substitution concept and provided support to counter some current education policy practices, such as school reconstitution.

In line with resource substitution, when teacher characteristics were associated with achievement disparities, they tended to be associated with *reduced* disparities. For example, poor Black and poor Hispanic children occasionally appeared to benefit more than non-poor White children from having teachers with the same human capital characteristics. Recall from Chapter 2, teacher certification is one of the characteristics that has been tested and shown to have *both* positive effects on child achievement

(Darling-Hammond, 2000) *and* no effect (Croninger, Rice, Rathbun, & Nishio, 2004) on student achievement outcomes. The findings from this study suggest that teacher certification could be instrumental in narrowing the gap between poor Black and Hispanic children and non-poor White children. This finding could reflect the way in which I analyzed the data. Previous studies have reported certification effects and other teacher effects solely by race/ethnic and/or economic categories rather than by their combination. The two groups that most consistently received a boost were the poor Black and poor Hispanic children, not poor children in general or Black and Hispanic children in general.

What we see here is a case for the highly specific nature of teacher human capital characteristics in relation to achievement disparities. In other words, early debates about whether teacher certification matters for student achievement may be resolved by looking at when, where, and for whom it matters. These findings suggests that it matters most for poor Black and poor Hispanic children.

These findings are quite significant in a policy context. A large part of the academic underperformance of public schools (as gauged by the testing data from NCLB) is rooted in the low performance of poor and minority children. Given these findings that having a certified teacher may provide some small degree of protection against these achievement gaps for poor Black and Hispanic children, certification programs may be especially beneficial for public schools serving these populations.

As for the more practical implications of these findings, one of the most controversial pieces of NCLB that is causing great opposition in the education community concerns school reconstitution. School reconstitution forces schools to

release all of the existing teachers in a consistently low-performing school and hire new teachers, with the hope of raising student achievement. One problem with this policy is that many of the schools that are being reconstituted are high-poverty and high-minority. Moreover, many of the teachers being brought into these schools do not hold the type of certification that this dissertation suggests could actually make a difference for the most at-risk children. This is largely due to districts having difficulty with recruiting certified teachers (Kane, Rockoff, & Staiger, 2006).

If certification matters to the extent shown in this study, to what degree could reconstituted schools benefit by having a strict policy of only hiring teachers with regular and/or elementary certification? The potential impact on policy decisions could be quite significant. To expand the pool of certified teachers, Gordon, Kain, and Staiger (2006) suggest that school districts broaden the pathways and scope of regular teacher certification. One way of doing this would be establish partnerships between other academic programs and the teacher preparation programs at a given University. An example of this is the University of Texas UTEACH Institute, which is a collaboration of the Colleges of Natural Sciences, Education, and Liberal Arts. This program is designed to recruit and train math and science majors to become teachers in a way that nontraditional certification paths may not. This program has proven successful and has been expanded to other states, such as California.

We can assume that teachers with regular certification undergo a somewhat standard preparation program and come into the classroom with some fundamental principles that may be specific to the grade level and age of the child. These developmentally appropriate teaching practices may translate into positive outcomes for

the child. In addition, teachers who undergo traditional certification are typically trained longer than those who undergo other types of certification or have no certification. To some degree we have to assume that the professionalization that takes place as part of certification is beneficial. The UTEACH model could be an alternative to what Gordon and colleagues (2006) suggest.

Limitations of this Study and Directions for Future Research

The topics of at-risk children, achievement disparities, and teacher effects (and the links between the three) have been studied extensively. This dissertation has made a contribution to this body of research, but, even as it corrected some limitation of previous research, it also was limited in various ways that need to be addressed in the future.

First, like NCLB itself, I focused on teacher characteristics that, although amenable to policy intervention, may not provide as much insight into what truly happens in classrooms. I attempted to address this issue by investigating whether math and reading instruction mediated the observed effects of teacher characteristics. This exploration did not pan out, however, because of the lack of observed main effects of teacher human capital characteristics on the achievement outcomes. Future research could benefit from use of classroom observational data (see NICHD EECRN 2005 as an example of such an observational protocol), which would reveal instructional approaches occurring in the classroom. These types of data could provide more insight into direct approaches that may affect change in student achievement outcomes and, in the process, achievement disparities.

Second, the consistent at-risk status of Black children, regardless of economic circumstances, deserves much more attention. Teacher human capital characteristics

provided some small evidence of potential policy remedies, but, given the size and consistency of the disparities in question and their apparent lack of connection to socioeconomic factors, the net needs to be cast much wider. Race matters, and I need to look into issues of differential treatment and discrimination at school, pedagogical instruction (Ladson-Billings, 1994), as well as non-school ecological factors to better understand why.

Third, in contrast to poor and non-poor Black children, poor and non-poor Hispanic children appeared to respond more positively to policy amenable factors within the school context; in this case, teacher human capital. The research suggests that initial language acquisition issues (for the child or the child's family) could be the issue early on that teachers with more human capital may be better able to address as children move through the system. Knowing more about what happens in the home prior to the child entering kindergarten and during those first three years of school could provide more insight into other factors that are contributing to early risk and the positive achievement gains over time for Hispanic children.

Fourth, economic status was measured in a relatively simple, although important and policy relevant, way: by the federal poverty line. Clearly, children (and race/ethnic groups) are stratified by numerous dimensions of socioeconomic status that lie on a continuum, and that stratification needs to be taken into account. For example, the full range of social class (e.g., income and wealth) differences need to be factored into the identification and "ranking" of disparities. Also important are non-income factors such as parents' education. Wealth, as described by Conley (1999-2000) is a stronger source of inequality than work and education for racial/ethnic groups and, therefore, should be

considered more seriously in empirical research. Unfortunately, ECLS-K does not include information on wealth.

Fifth, although this study is longitudinal, it focused only on kindergarten to third grade. This focus was justified based on a reading of the relevant literature, but I realize that I have left out the vast majority of the educational career. Moreover, even within the focal time frame, the available information was lacking. For example, as I observed with the reading change scores, the change in at-risk groups transitioned from an economic focus to a race focus between first and third grade. I did not have information on what happened during the year between first and third grade (in other words, second grade) that could have had a significant impact on gains made between these two time points. Additional information would have been helpful. Analyzing the data to the end of elementary school and/or up through middle school may eventually shed light on the early trends studied here, particularly on whether they persist and whether potential protective factors change from stage to stage.

Sixth, I found evidence of a positive association between teacher knowledge, as measured by performance on certification exams, and student achievement. The ECLS-K data set does not provide information on teacher scores on licensing exams and therefore, I could not factor in teacher content knowledge in my analysis. This data could prove critical, particularly when looking at this connection in the early grades where content knowledge is diffused across subject matter and exploring the effects over-time.

Conclusion and Significance of Study

One contribution of this dissertation is a simple but important one. It recognized the substantial overlap between race/ethnic and economic stratification rather than teasing

apart each as a separate form of inequality. In doing so, I was able to determine how two forms of risk, in combination, related to achievement gains over time. Another contribution was that this dissertation revealed some limited evidence that teacher human capital characteristics could serve as protective factors for the most at-risk groups of children—a buffering mechanism in which teachers can provide the inside information, advocacy, and assistance that might be more difficult for parents from historically disenfranchised groups or be more actively blocked by school personnel when coming from such parents. A final contribution is that I have taken steps to promote causal inferences needed for policy intervention. To account for additivity violations (e.g., when alternate samples are missed or underrepresented) and independence violations (e.g., when confounds are not taken into account), I employed multiple imputation, used a large set of control variables for observable confounds, and drew on a class of statistics developed by educational statisticians (robustness indices) to address the impact of unobservable confounds. These steps did not establish the causal impact needed to make the most sound policy recommendations. Only experimental studies can do that. Still, what I have done has gone a long way towards addressing the most basic concerns about misattributed causality.

The findings of this dissertation also have implications for the broader policy argument about multiple forms of inter-related achievement gaps and what can be done to close such gaps. On example of a policy change that could be influenced by these findings, if confirmed by future studies, is NCLB's school reconstitution provision—the removal of the majority of teachers and staff in persistently low-performing schools (Hassel, Hassel, Arkin, Kowal & Steiner, 2006; Spitser, 2007). Specifically, how much

can we expect teachers with these human capital characteristics to reduce the achievement gap and what characteristics serve as academic protective factors for the most at-risk children? NCLB suggests that these characteristics are the focal factors necessary for reducing disparities. Although this dissertation joins with some other studies to identify some protective power of these teacher factors, they clearly cannot be viewed as the sole approach.

Table 1
Descriptive Statistics for Study Variables

	Kindergarten	First Grade	Third Grade
Child Academic Achievement (M/SD)			
Math test score	*21.77*	*54.95*	
	(9.02)	*(15.98)*	
Change in math test score (k-1st)		*33.17*	
		(11.74)	
Change in math test score (1st-3rd)			*29.61*
			(11.53)
Reading test score	*27.39*	*68.27*	
	(10.23)	*(20.74)*	
Change in reading test score (k-1st)		*40.82*	
		(16.06)	
Change in reading test score (1st-3rd)			*39.18*
			(16.34)
Race/Ethnicity(%) and Economic Status			
White (%)	57.26		
Black (%)	13.00		
Hispanic (%)	17.83		
Asian-American (%)	6.54		
Other (%)	5.39		
185% of the Federal Poverty Line	39.31		
Teacher Characteristics			
Level of education (% with masters or higher)	34.62	37.39	43.32
Type of certification (% regular)	86.54	72.20	88.33
Elementary certification (%)	85.09	87.53	93.21
Grade tenure	*9.37*	*12.89*	*8.12*
	(7.52)	*(15.33)*	*(6.69)*
School tenure	*9.69*	*15.61*	*9.86*
	(7.77)	*(16.93)*	*(7.77)*
Paid professional development	23.57	22.48	
Teacher age	*42.03*		
	(9.99)		
Teacher Race/Ethnicity			
White (%)	81.19		
Black (%)	5.87		
Hispanic (%)	6.06		
Asian-American (%)	2.36		
Other (%)	1.21		
Family Controls			
Parent education (M/SD)	*2.96*		
	(1.16)		
Family structure (two-parent)	73.85		
Mother employed full-time (%)	38.81	42.42	41.71
Mother employed part-time (%)	19.06	20.15	20.36
Mother not employed (%)	27.34	26.43	22.92
Mother absent (%)	13.44	1.75	2.00
Immigration status (%)	20.81		

Table 1 continued on next page

Table 1 continued

	Kindergarten	First Grade	Third Grade
Child Controls			
Age (years at start of school) (M/SD)	*5.70*		
	(0.36)		
Gender (% female)	49.13		
Spanish assessment language status (%)	5.14	1.74	
Timing of assessment (M/SD)	*60.81*	*65.23*	*59.84*
	(17.59)	*(17.23)*	*(19.67)*
Pre-K not in child care (%)	15.84		
Pre-K relative care (%)	11.90		
Pre-K non-relative care (%)	9.13		
Pre-K day care (%)	6.18		
Pre-K preschool care (%)	31.28		
Pre-K Head Start (%)	7.52		
Pre-K other type of care (%)	4.14		
School Controls			
School sector (% private)	21.45	19.45	18.02
School size (M/SD)	*3.29*	*3.40*	*3.37*
	(1.16)	*(1.15)*	*(1.09)*
School poverty rate (M/SD)	*29.59*	*27.54*	*31.77*
	(27.68)	*(28.51)*	*(29.01)*
Minority representation (%)	*35.04*	*35.76*	*36.59*
	(33.89)	*(34.17)*	*(34.08)*
Receipt of title I funding (%)	51.94	52.52	50.30
School region: Midwest (%)	25.86		
School region: Northeast (%)	18.65		
School region: South (%)	32.94		
School region: West (%)	22.55		
School urbanicity: central city (%)	46.74	38.37	37.41
School urbanicity: fringe/large town (%)	30.79	40.15	40.86
School urbanicity: small town/rural (%)	22.48	21.49	21.73
Teacher Classroom Instructional Mediators			
Measurement	*2.75*	*3.49*	
	(0.79)	*(0.77)*	
Spatial	*4.01*	*3.54*	
	(0.94)	*(0.89)*	
Number operations	*3.44*	*4.28*	
	(1.34)	*(0.99)*	
Comprehension	*3.63*	*4.14*	
	(1.34)	*(0.96)*	
Mechanics	*1.20*	*2.67*	
	(0.67)	*(1.24)*	
Whole language	*4.22*	*4.59*	
	(0.78)	*(0.55)*	
Phonics	*4.54*	*4.48*	
	(0.61)	*(0.91)*	

N = 14887

Note. Families at or below 185% of the FPL are "poor" and families above 185% of the FPL are "non-poor."

Table 2

Distribution of Race-Economic Typology

	%
Race/Ethnicity by Economic Status	
White poor	14.09
Black poor	8.76
Hispanic poor	10.98
Asian-American poor	2.68
Other race/ethnicity poor	2.80
White non-poor	43.16
Black non-poor	4.24
Hispanic non-poor	6.84
Asian-American non-poor	3.85
Other race/ethnicity non-poor	2.59

(N = 14887)

Table 3

Results of Multilevel Models Predicting Kindergarten Math and Reading Test Scores (n = 14,887)

	Unstandardized *B* Coefficients			
	Math		Reading	
Variable	Model 1	Model 2	Model 1	Model 2
White poor	-2.95***	-1.05***	-2.99***	-0.91**
Black poor	-5.80***	-3.05***	-4.98***	-2.28***
Hispanic poor	-6.93***	-2.85***	-5.66***	-2.60***
Asian-American poor	-2.02**	0.43	-2.72**	-0.26
Black non-poor	-3.92***	-2.79***	-2.11***	-1.09**
Hispanic non-poor	-3.34***	-1.92***	-3.12***	-2.09***
Asian-American non-poor	0.43	0.59	1.84**	1.64*
Gender (female)		-0.25+		1.25***
Immigration status		-0.33		-0.15
Pre-K relative care		0.19		0.21
Pre-K non-relative care		1.10**		0.72*
Pre-K day care		1.23***		1.17**
Pre-K preschool care		1.78***		2.05***
Pre-K Head Start		-0.28		-0.54
Pre-K other type of care		0.77*		0.48
Assessment language status		-2.91***		---
Timing of assessment		-0.01		-0.01
Parent education		1.61***		1.66***
Mother employed full time		-0.20		-1.07+
Mother employed part time		0.36		-0.46
Mother not employed		-0.08		-0.73
School sector		1.48**		1.48**
School size		0.02		0.01
School poverty rate		0.00		-0.04
Minority representation		-0.00+		-0.00+
Receipt of title I funding		-0.82**		-0.85**
School region: midwest		-0.11		-0.86*
School region: northeast		-0.61+		-0.75+
School region: west		-0.38		-0.47
School urbancity: central city		1.63***		1.66***
School urbanicity: fringe/large town		0.43		0.34
Black teacher		0.49		0.19
Hispanic teacher		-0.03		0.06
Asian-American teacher		-0.33		-0.34
Other teacher		-1.24		-1.33
Teacher age		-0.00		-0.01

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Note. White was the reference category for race/ethnicity, maternal care for pre-K care, not employed for maternal employment, south for region, and rural for urbanicity.

Table 4

Results of Multilevel Models Predicting Change in Math Test Scores between Kindergarten and First Grade (n = 14,887)

	Unstandardized *B* Coefficients		
Variable	Model 1	Model 2	Model 3
Kindergarten math score	0.23***	0.19***	0.19***
White poor	-2.32***	-1.38**	-1.36**
Black poor	-5.19***	-3.72***	-3.67***
Hispanic poor	-2.07***	0.05	0.05
Asian-American poor	-3.71**	-2.19	-2.19*
Black non-poor	-3.75***	-3.27***	-3.25***
Hispanic non-poor	-1.84***	-1.16**	-1.15**
Asian-American non-poor	-1.97*	-1.79*	-1.79*
Gender (female)		-0.91***	-0.91***
Immigration status		-0.24	-0.23
Pre-K relative care		0.38*	0.38
Pre-K non-relative care		0.79**	0.79*
Pre-K day care		0.37**	0.35
Pre-K preschool care		-0.02*	-0.01
Pre-K Head Start		-1.79*	-1.79***
Pre-K other type of care		-0.19*	0.15
Assessment language status		-1.74**	-1.44***
Timing of assessment		0.05***	0.05***
Parent education		1.06***	1.06***
Mother employed full time		0.69	0.69*
Mother employed part time		0.85	0.86*
Mother not employed		1.09**	1.10**
Two-parent family		0.28	0.28
School sector		0.22	-0.55
School size		0.28+	0.28+
School poverty rate		0.02	-0.00
Minority representation		0.00	-0.00
Receipt of Title I funding		0.14	0.16
School region: midwest		-1.35**	-1.03**
School region: northeast		-3.49***	-3.58***
School region: west		-0.93*	-1.03**
School urbancity: central city		0.34	0.38
School urbanicity: fringe/large town		0.35	0.38
Black teacher		-0.23	-0.23
Hispanic teacher		-0.52	-0.51
Asian-American teacher		0.34	0.34
Other teacher		-0.35	-0.35
Teacher age		0.01	0.01
Teacher Characteristics			
Certification type			-0.34
Elementary certification			1.02**
Teacher education			-0.06
Tenure in grade			-0.01
Tenure in school			0.01
Paid professional development			-0.00

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Note. White was the reference category for race/ethnicity, maternal care for pre-K care, not employed for maternal employment, south for region, and rural for urbanicity.

Table 5

Results of Multilevel Models Predicting Change in Reading Test Scores between Kindergarten and First Grade (n = 14,887)

	Unstandardized *B* Coefficients		
Variable	Model 1	Model 2	Model 3
Kindergarten reading score	0.32***	0.26***	0.26***
White poor	-2.99***	-0.90**	-0.92**
Black poor	-4.98***	-2.29***	-2.31***
Hispanic poor	-5.66***	-2.59***	-2.64***
Asian-American poor	-2.72**	-0.29	-0.39
Black non-poor	-2.11***	-1.09**	-1.07**
Hispanic non-poor	-3.12***	-2.09***	-2.08***
Asian-American non-poor	1.84**	1.63*	1.59*
Gender (female)		1.26***	1.27***
Immigration status		-0.14	-0.15
Pre-K relative care		0.21	0.34
Pre-K non-relative care		0.73**	0.86**
Pre-K day care		1.17**	1.31**
Pre-K preschool care		2.05***	2.15***
Pre-K Head Start		-0.54	-0.46
Pre-K other type of care		0.47	0.62
Timing of assessment		0.01	0.01
Parent education		1.66	1.65
Mother employed full time		0.10	0.27
Mother employed part time		0.73	0.88
Mother not employed		0.46	0.55
Two-parent family		0.89	0.91
School sector		1.48**	1.61**
School size		0.01	0.02
School poverty rate		-0.04	-0.04
Minority representation		-0.00	-0.04
Receipt of Title I funding		-0.86**	-0.79**
School region: midwest		-0.87*	-0.87**
School region: northeast		-0.76+	-0.81+
School region: west		-0.47	-0.53
School urbancity: central city		1.66***	1.57**
School urbanicity: fringe/large town		0.32	0.32
Black teacher		1.01**	1.02**
Hispanic teacher		0.04	-0.02
Asian-American teacher		0.32	0.26
Other teacher		-0.86	-0.92
Teacher age		-0.01*	0.01
Teacher Characteristics			
Certification type			-0.11
Teacher education			-0.07
Tenure in grade			-0.00
Tenure in school			-0.03
Paid professional development			0.10

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Note. White was the reference category for race/ethnicity, maternal care for pre-K care, not employed for maternal employment, south for region, and rural for urbanicity.

Table 6

Results of Multilevel Models Predicting Change in Math Test Scores between First and Third Grade

	Unstandardized *B* Coefficients		
Variable	Model 1	Model 2	Model 3
First Grade math score	-0.15***	-0.18***	-0.18***
White poor	-2.01***	-1.02**	-1.02**
Black poor	-6.06***	-4.58***	-4.59***
Hispanic poor	-2.41	-0.84+	-0.83+
Asian-American poor	-0.99	-0.53	-0.52
Black non-poor	-2.79***	-2.36***	-2.36***
Hispanic non-poor	-0.39	0.07	0.07
Asian-American non-poor	1.21	0.67	0.67
Gender (female)		-1.88***	-1.89***
Immigration status		0.89*	0.88*
Pre-K relative care		-0.24	-0.23
Pre-K non-relative care		1.72***	1.69***
Pre-K day care		1.11**	1.09**
Pre-K preschool care		0.91**	0.90**
Pre-K Head Start		-0.75*	-0.75+
Pre-K other type of care		0.88+	0.89+
Assessment language status		-6.84***	-6.81***
Timing of assessment		-0.05***	-0.05***
Parent education		0.97***	0.95***
Mother employed full time		0.20	0.21
Mother employed part time		0.16	0.17
Mother not employed		-0.18	-0.18
Two-parent family		0.22	0.22
School sector		-2.06***	-1.86***
School size		0.19	0.19
School poverty rate		-0.00	-0.00
Minority representation		0.00	0.00
Receipt of Title I funding		-0.55*	-0.56*
School region: midwest		-0.36	-0.33
School region: northeast		0.83+	0.91*
School region: west		0.35	0.47
School urbancity: central city		1.47**	1.44**
School urbanicity: fringe/large town		1.46**	1.47**
Black teacher		-0.92*	-0.90*
Hispanic teacher		0.71	0.73
Asian-American teacher		0.82	0.72
Other teacher		0.03	0.01
Teacher age		0.01	0.01
Teacher Characteristics			
Certification type			0.66*
Elementary certification			-0.16
Teacher education			-0.00
Tenure in grade			0.01
Tenure in school			-0.01
Paid professional development			0.40

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Note. White was the reference category for race/ethnicity, maternal care for pre-K care, not employed for maternal employment, south for region, and rural for urbanicity.

Table 7

Results of Multilevel Models Predicting Change in Reading Test Scores between First and Third Grade (n = 14,887)

	Unstandardized B Coefficients		
Variable	Model 1	Model 2	Model 3
First Grade reading score	-0.35***	-0.37***	-0.37***
White poor	-3.62***	-1.51**	-1.52**
Black poor	-7.67***	-4.42***	-4.43***
Hispanic poor	-6.83***	-2.12**	-2.13**
Asian-American poor	-5.95***	-2.43+	-2.43+
Black non-poor	-6.11***	-4.51***	-4.51***
Hispanic non-poor	-2.45***	-0.59	-0.59
Asian-American non-poor	-3.46**	-2.35**	-2.33**
Gender (female)		1.48***	1.48***
Immigration status		-1.03**	-1.04**
Pre-K relative care		1.36**	1.37**
Pre-K non-relative care		2.95***	2.93***
Pre-K day care		2.03**	2.03**
Pre-K preschool care		1.39**	1.39**
Pre-K Head Start		0.21	0.21
Pre-K other type of care		1.86**	1.87**
Parent education		1.96***	1.96***
Timing of assessment		-0.03***	-0.03**
Mother employed full time		1.22**	1.23**
Mother employed part time		1.12*	1.13**
Mother not employed		0.92*	0.92**
Two-parent family		0.45	0.46
School sector		-0.85+	-0.81
School size		0.42**	0.42**
School poverty rate		-0.01+	-0.01+
Minority representation		-0.00	0.00
Receipt of Title I funding		-0.74*	-0.74*
School region: midwest		0.69	0.74**
School region: northeast		0.74	0.81+
School region: west		0.69	0.75
School urbancity: central city		0.66	0.66
School urbanicity: fringe/large town		1.06*	1.06*
Black Teacher		-0.68	-0.67
Hispanic Teacher		-2.69**	-2.68**
Asian-American Teacher		3.06**	-3.08**
Teacher Age		0.01	0.01
Teacher Characteristics			
Certification type			0.36
Elementary certification			-0.25
Teacher education			-0.08
Tenure in grade			0.00
Tenure in school			0.00
Paid professional development			0.14

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Note. White was the reference category for race/ethnicity, maternal care for pre-K care, not employed for maternal employment, south for region, and rural for urbanicity.

Table 8

Significant Race/Poverty x Teacher Interactions from Multilevel Models Predicting Change in Math Test Scores between Kindergarten and First Grade (n = 14,887)

	Unstandardized B Coefficients			
Variable	Model 1	Model 2	Model 3	Model 4
Race/Poverty x Certification Type				
White poor x certification type	1.51			
Black poor x certification type	2.48*			
Hispanic poor x certification type	0.82			
Asian-American poor x certification type	0.31			
Black non-poor x certification type	1.20			
Hispanic non-poor x certification type	-0.65			
Asian-American non-poor x certification type	1.63			
Race/Poverty x Elementary Certification				
White poor x elementary certification		1.61		
Black poor x elementary certification		1.18+		
Hispanic poor x elementary certification		3.52**		
Asian-American poor x elementary certification		-0.46		
Black non-poor x elementary certification		1.24		
Hispanic non-poor x elementary certification		-0.38		
Asian-American non-poor x elementary certification		1.61		
Race/Poverty x School Tenure				
White poor x school tenure			0.08+	
Black poor x school tenure			0.01	
Hispanic poor x school tenure			0.04	
Asian-American poor x school tenure			-0.01	
Black non-poor x school tenure			0.17*	
Hispanic non-poor x school tenure			-0.04	
Asian-American non-poor x school tenure			-0.00	
Race/Poverty x Paid Professional Development				
White poor x professional development				-0.53
Black poor x professional development				-1.59**
Hispanic poor x professional development				-0.31
Asian-American poor x professional development				-1.90+
Black non-poor x professional development				-0.97
Hispanic non-poor x professional development				-1.02*
Asian-American non-poor x professional development				-1.13

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. *Note*. All models included the full set of control variables, family economic disadvantage, teacher characteristic mediators, and kindergarten test score.

Table 9

Significant Race/Poverty x Teacher Interactions from Multilevel Models Predicting Change in Reading Test Scores between Kindergarten and First Grade (n = 14,887)

	Unstandardized B Coefficients		
Variable	Model 1	Model 2	Model 3
Race/Poverty x Elementary Certification			
White poor x elementary certification	2.44+		
Black poor x elementary certification	0.38		
Hispanic poor x elementary certification	5.33**		
Asian-American poor x elementary certification	3.64		
Black non-poor x elementary certification	0.30		
Hispanic non-poor x elementary certification	0.54		
Asian-American non-poor x elementary certification	2.94		
Race/Poverty x Teacher Education			
White poor x teacher education		0.32	
Black poor x teacher education		0.45	
Hispanic poor x teacher education		1.50**	
Asian-American poor x teacher education		-0.15	
Black non-poor x teacher education		1.05	
Hispanic non-poor x teacher education		-2.00*	
Asian-American non-poor x teacher education		0.97	
Race/Poverty x Paid Professional Development			
White poor x professional development			0.13
Black poor x professional development			-1.46*
Hispanic poor x professional development			1.62**
Asian-American poor x professional development			-1.24
Black non-poor x professional development			0.25
Hispanic non-poor x professional development			-0.49
Asian-American non-poor x professional development			-1.49

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. *Note.* All models included the full set of control variables, family economic disadvantage, teacher characteristic mediators, and kindergarten test score.

Table 10

Significant Race/Poverty x Teacher Interactions from Multilevel Models Predicting Change in Math Test Scores between First Grade and Third Grade (*n* = 14,887)

Variable	*Unstandardized B Coefficients*
Race/Poverty x Certification Type	
White poor x certification type	1.38*
Black poor x certification type	1.89**
Hispanic poor x certification type	1.52*
Asian-American poor x certification type	3.69+
Black non-poor x certification type	0.84
Hispanic non-poor x certification type	0.37
Asian-American non-poor x certification type	4.07**

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. *Note.* All models included the full set of control variables, family economic disadvantage, teacher characteristic mediators, and first grade test score.

Table 11

Significant Race/Poverty x Teacher Interactions from Multilevel Models Predicting Change in Reading Test Scores between First Grade and Third Grade (n = 14,887)

	Unstandardized B Coefficients		
Variable	Model 1	Model 2	Model 2
Race/Poverty x Certification Type			
White poor x certification type	1.98*		
Black poor x certification type	2.46**		
Hispanic poor x certification type	3.02**		
Asian-American poor x certification type	4.62+		
Black non-poor x certification type	3.66**		
Hispanic non-poor x certification type	-0.89		
Asian-American non-poor x certification type	1.80		
Race/Poverty x Grade Tenure			
White poor x grade tenure		-0.03	
Black poor x grade tenure		-0.06**	
Hispanic poor x grade tenure		-0.06**	
Asian-American poor x grade tenure		-0.06	
Black non-poor x grade tenure		-0.10**	
Hispanic non-poor x grade tenure		0.06*	
Asian-American non-poor x grade tenure		-0.03	
Race/Poverty x School Tenure			
White poor x school tenure			-0.05
Black poor x school tenure			-0.05+
Hispanic poor x school tenure			-0.06
Asian-American poor x school tenure			-0.04
Black non-poor x school tenure			-0.11*
Hispanic non-poor x school tenure			0.03
Asian-American non-poor x school tenure			-0.07

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. *Note.* All models included the full set of control variables, family economic disadvantage, teacher characteristic mediators, and first grade test score.

Table 12

Results of Teacher Classroom Instructional Characteristics Mediating Teacher Human Capital Characteristics in Math (n = 14,887)

	Unstandardized *B* Coefficients	
Variable	Kindergarten-First Grade	First Grade- Third Grade
Certification type	-0.36	0.67*
Elementary certification	1.04*	-0.21
Teacher education	-0.08	-0.01
Tenure in grade	-0.01	0.01
Tenure in school	0.02	-0.01
Paid professional development	-0.01	0.39*
Measurement	0.20	-0.05
Spatial	-0.28	-0.01
Number operations	0.22*	-0.11
Comprehension	0.16	0.25*
Mechanics	-0.04	-0.19

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. *Note.* All models included the full set of control variables, family economic disadvantage, teacher characteristic mediators, and kindergarten or first grade test score.

Table 13

Results of Teacher Classroom Instructional Characteristics Mediating Teacher Human Capital Characteristics in Reading (n = 14,887)

	Unstandardized *B* Coefficients	
Variable	Kindergarten-First Grade	First Grade- Third Grade
Certification type	-0.20	0.37
Elementary certification	1.44**	-0.27
Teacher education	-0.10	-0.07
Tenure in grade	0.05	0.00
Tenure in school	-0.07**	0.00
Paid professional development	0.27	0.14
Whole Language	-0.28	-0.12
Phonics	1.28**	-0.22

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. *Note.* All models included the full set of control variables, family economic disadvantage, teacher characteristic mediators, and kindergarten or first grade test score.

Figure 1. Resource Substitution and Resource Amplification Models

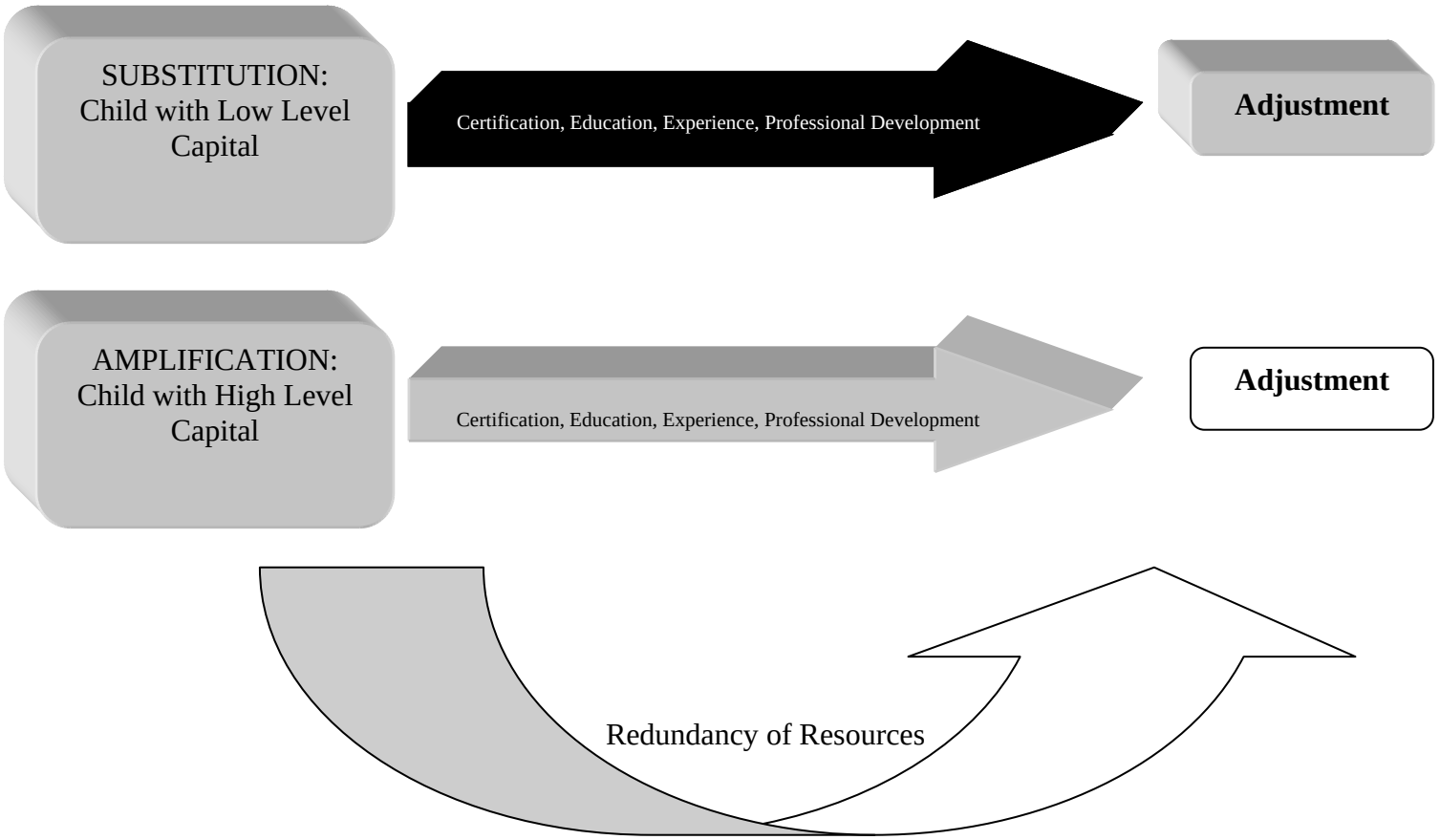


Figure 2. Mediation Model

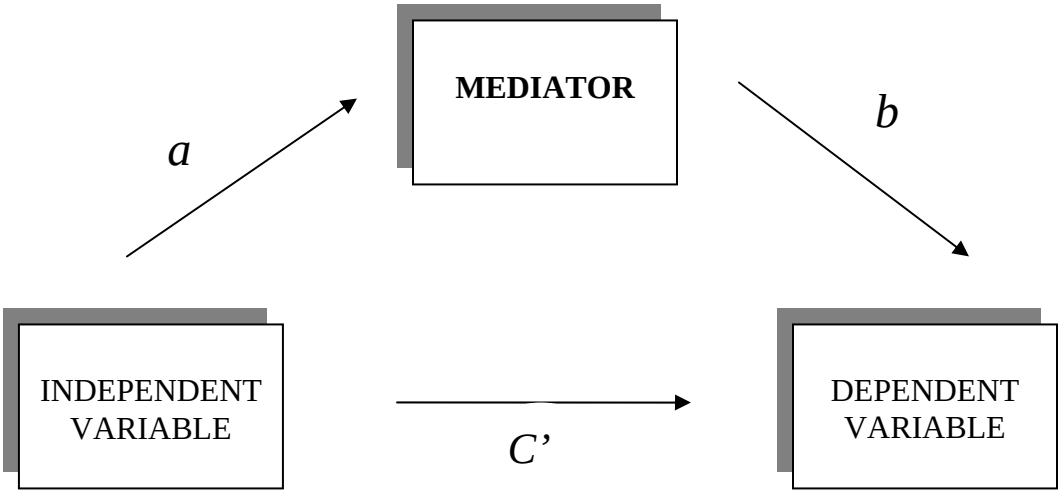


Figure 3. Links between Elementary Certification and Math Gains from Kindergarten to First Grade, by Race/Ethnicity and Economic Status

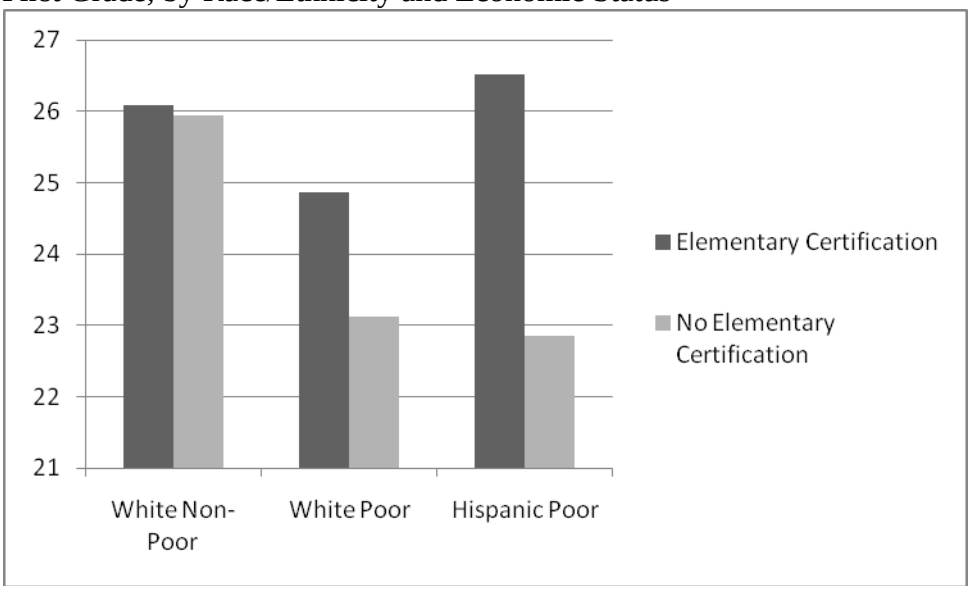


Figure 4. Links between Certification Type and Reading Gains from Kindergarten to First Grade, by Race/Ethnicity and Economic Status

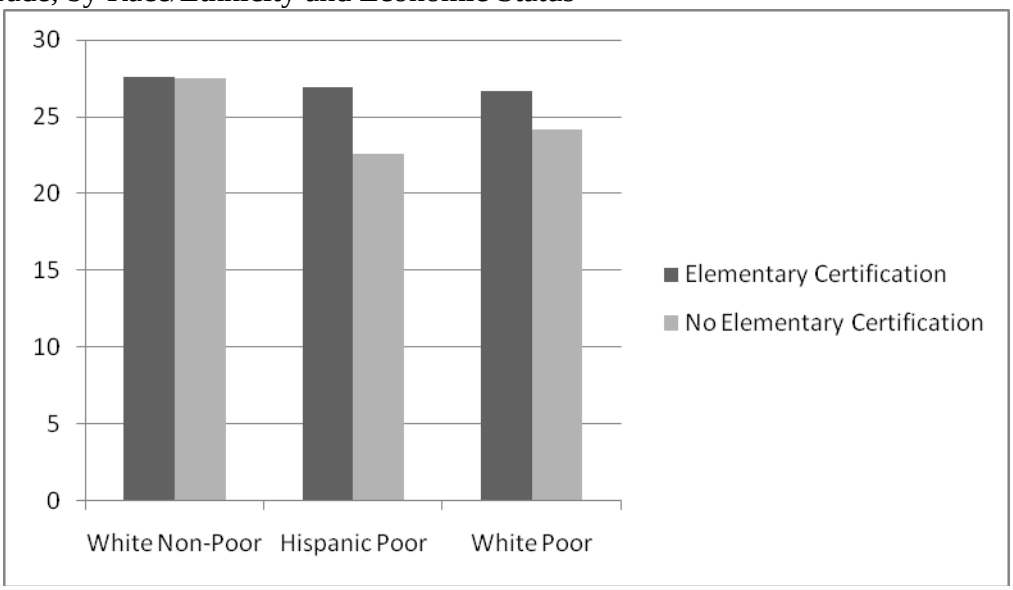


Figure 5. Links between Certification Type and Math Gains from First to Third Grade, by Race/Ethnicity and Economic Status

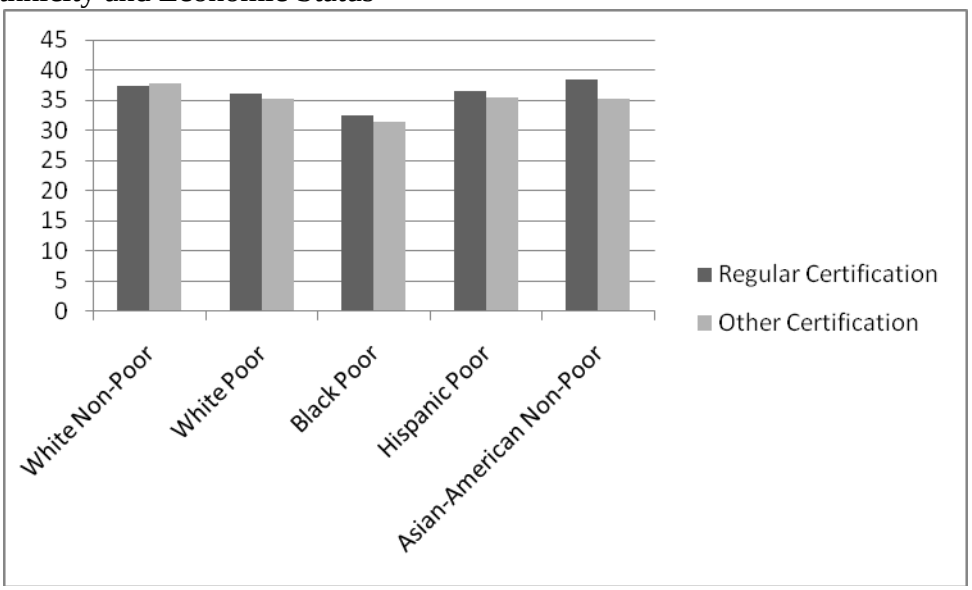
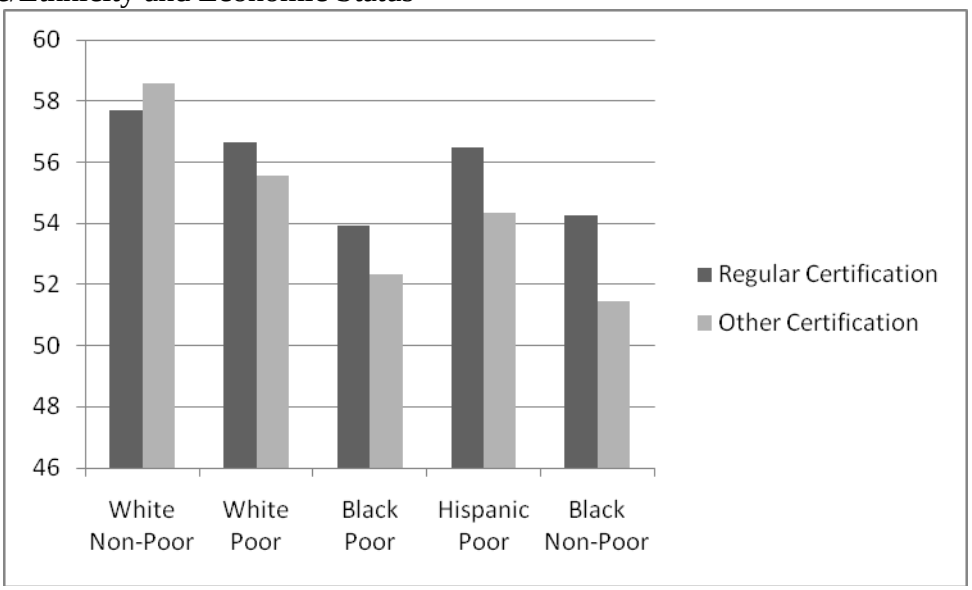


Figure 6. Links between Certification Type and Reading Gains from First to Third Grade, by Race/Ethnicity and Economic Status



REFERENCES

Alexander, K., Entwisle, D., & Olson, L. (2007). Lasting Consequences of the Summer Learning Gap. *American Sociological Review, 72*(2), 167-180.

Alexander, K. & Entwisle, D. (1988). Achievement in the first two years of school: Patterns and processes. *Monographs of the Society for Research in Child Development, 53*(2), 1-140.

Allison, P. (1990). Change scores as dependent variables in regression analysis. *Sociological Methodology, 20*, 93-114.

Allison, P. (2001). *Missing data*. Thousand Oaks, CA: Sage.

Ballou, D. & Podgursky, M. (2000). Reforming teacher preparation and licensing: What is the evidence? *Teachers College Record 102*(1), 5-27.

Barnett, S., Hustedt, J. T., Robin, K. B., & Schulman, K. L. (2004). The state of preschool: 2004 State preschool yearbook. Retrieved November 12, 2008 from http://nieer.org/yearbook2004/.

Borman, G.D. & Overman, L.T. (2004). Academic resilience in mathematics among poor and minority students. *Elementary School Journal, 104*(3), 177-195.

Bourdieu, P. 1977. Cultural reproduction and social reproduction. In J. Karabel, and A.H., Halsey (Eds.), *Power and ideology in education*, (pp. 487–511). New York: Oxford University Press.

Campbell, J. R., Hombo, C. M., & Mazzeo, J. (2000). *NAEP 1999 trends in academic progress: Three decades of student performance*. Washington, DC: U.S. Department of Education Office of Educational Research and Improvement.

Carter, P. (2003). Black cultural capital, status positioning, and schooling conflicts fro low-income African American youth. *Social Problems, 50*(1), 136-155.

Ceci, S.J. & Papierno, P.B. (2005). The rhetoric and reality of gap closing: When the "have-nots" gain but the "haves" gain even more. *American Psychologist, 60*(2), 149-160.

Clotfelter, C. T., Ladd, H.F., & Vigdor, J. L. (2007). Teacher credentials and student achievement in high school: A cross-subject analysis with student fixed effects. NBER Working Paper No. 13617, National Bureau of Economic Research.

Clotfelter, C. T., Ladd, H.F., & Vigdor, J. L., & Wheeler, J. (2006). Teacher-student matching and the assessment of teacher effectiveness. NBER Working Paper No. 11936, National Bureau of Economic Research.

Coleman, J., Campbell, E., Hobson, C., McPartland, J., Mood, A., Weinfield, F., & York, R. (1966). *Equality of educational opportunity*. Washington DC: U.S. Government Printing Office.

Condron, D. J. & Roscigno, V. J., (2003). Disparities within: Unequal spending and achievement in an urban school district. *Sociology of Education 76*(1), 18-36.

Conley, D. (1999-2000). Getting into the black: Race, wealth and public policy. *Political Science Quarterly, 114*(4), 595-612.

Corcoran, M., (2001). Mobility, persistence and the consequences of poverty. In S. H. Danzinger, & R. H Haveman (Eds.), *Understanding Poverty* (pp 127-161). New York, New York: Russell Sage Foundation.

Croninger, R., Rice, J., Rathbun, A., & Nishio, M. (2007). Teacher qualifications and early learning: Effects of certification, degree, and experience on first-grade student achievement. *Economics of Education Review, 26*(3), 312-324.

Crosnoe, R. (2005). Double disadvantage or signs of resilience? The elementary school contexts of children from Mexican immigrant families. *American Educational Research Journal 42*(2), 269-303.

Danziger, S. H., Sandefur, G.D., & Weinberg, D. H. (Eds.). (1994). *Confronting poverty: Prescriptions for change*. Cambridge, MA: Harvard University Press.

Darling-Hammond, L., Holtzman, D. J., Gatlin, S. J., & Vasquez Heilig. J. (2005). Does teacher preparation matter? Evidence about teacher certification, teach for America, and teacher effectiveness. *Education Policy Analysis Archives 13*(42), 1-51.

Darling-Hammond, L. (2000). Teacher quality and student achievement: A review of state policy evidence. *Education Policy Analysis Archives, 8*(1). Retrieved October 20, 2006 from http://epaa.asu.edu/epaa/v8n1/.

Darling-Hammond, L. (2000). Reforming teacher preparation and licensing: Debating the evidence. *Teachers College Record, 102*(1), 28-56.

Denton, K. & West, J. (2002). Children's reading and mathematics achievement in kindergarten and first grade. Washington DC: U.S. Department of Education.

Dickens, W. T., Sawhill, I., & Tebbs, J. (2006). The effects of investing in early education on economic growth. Policy Brief #153, Washington, DC: Brookings Institution.

Dornbusch, S., Glasgow, K., & Lin, I. (1996). The social structure of schooling. *Annual Review of Psychology, 47*(1), 401-429.

Duncan, G. & Brooks-Gunn, J. (1997). *Consequences of growing up poor*. New York: Russell Sage Foundation.

Duncan, G. J., Brooks-Gunn, J., Yeung, W. J., & Smith, J. R. (1998). How much does childhood poverty affect the life chances of children? *American Sociological Review, 63*(3), 406-423.

Duncan, G., Huston, A., & Weisner, T. (2007). *Higher ground: New hope for the working poor and their children*. New York: Russell Sage Foundation.

Duncan, G., Dowsett, C., Claessens, A., Magnuson, K., Huston, A., Klebanov, P., Pagani, L. S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., Duckworth, K., & Japel, C. (2007). School readiness and later achievement. *Developmental Psychology, 43*(6), 1428-1446.

Duncan, G. J., Magnuson, K., & Ludwig, J. (2004). The endogeneity problem in developmental studies. *Research in Human Development, 1*, 59-80.

Entwisle, D.R., Alexander, K. L., & Olson, L, S., (2005). First grade and educational attainment by age 22: A new story. *American Journal of Sociology 110*(5), 1458-1502.

Ferguson, R.F. (1991). Racial patterns in how school and teacher quality affect achievement and earnings. *Challenge: A Journal of Research on Black Men*.

Flanagan, C. & Eccles, J. (1993). Changes in parents' work status and adolescents' adjustment at school. *Child Development, 64*, 246-257.

Frank, K. A. (2000). Impact of a confounding variable on a regression coefficient. *Sociological Methods and Research, 29*, 147-194.

Frank, K.A. & Min, K. (2007). Indices of robustness for sample representativeness. *Sociological Methodology, 37*(1), 349-392.

Fryer, R. G. & Levitt. D. (2004). Understanding the black-white test score gap in the first two years of school. *Review of Economics and Statistics 86* (2), 447–464.

Fuller, B. (2007). *Standardized childhood: The political and cultural struggle over early education.* Palo Alto, CA: Stanford University Press.

Furstenberg, F., Cook, T., Eccles, J., Elder, G. H., Jr., & Sameroff, A. (1999). *Managing to make it: Urban families and adolescent success*. Chicago, IL: University of Chicago Press.

Glazerman, S., Levy, D., & Myers, D. (2003). Nonexperimental versus experimental estimates of earnings impacts. *Annals of the American Academy of Political and Social Science*, Online 589, 63-85.

Goldhaber, D. D. & Brewer, D. J. (2000). Does teacher certification matter? High school teacher certification status and student achievement. *Educational Evaluation and Policy* Analysis, 22(2), 129-45.

Gordon, R., Kane, T. J., & Staiger, D. O. (2006). *Identifying effective teachers using performance on the job*. Washington, DC: Brookings Institution.

Grissmer, D., Flanagan, A., & Willamson, S. (1998). Why did the black-white score gap narrow in the 1970s and 1980s? In C. Jencks & M. Phillips (Eds.), The black-white test score gap (pp. 182–226). Washington, DC: Brookings Institution Press.

Guilkey, D. & Murphy, J. (1993). Estimation and testing in the random effects probit model. *Journal of Econometrics, 59*, 301-317.

Hanushek, E. (2003). The failure of input-base schooling policies. *The Economic Journal, 113*(485), F64-F98.

Hanushek, E. (1971). Teacher characteristics and gains in student achievement: Estimation using micro-data. *The American Economic Review, 61*(2), 280-288.

Hassel, E. A., Hassel, B. C., Arkin, M. D., Kowal, J. K., & Steiner, L. M. (2006). School restructuring under No Child Left Behind: What works when? A guide for education leaders. Washington, DC: Center for Comprehensive School Reform and Improvement.

Heckman, J. (2006). Skill formation and the economics of investing in disadvantaged children. *Science, 312*(5782), 1900-1902.

Heckman, J. (2008). Role of income and family influence on child outcomes. *Annals of the New York Academy of Science, 1136,* 307-323.

Herrnstein, R.J. & Murray. C. (1994). *The bell curve: Intelligence and class structure in American life*. New York: Free Press.

Iceland, J. (2003). Why poverty remains high: The role of income growth, economic inequality, and changes in family structure, 1949-1999. *Population Association of America, Demography, 40*(3), 499-519.

Jencks, C. & Phillips, M. (1998). The black-white test score gap: An introduction. In C. Jencks and M. Phillips (Eds.), *The black-white test score gap* (pp. 1-51). Washington, DC: Brookings Institution.

Kane, T. J., Rockoff, J. E., & Staiger, D. O. (2006). What does certification tell us about teacher effectiveness? Evidence from New York City Cambridge: National Bureau of Economic

Research.

Kingston, P.W., Hubbard, R., Lapp, B., Schroeder, P., & Wilson, J. (2003). Why education matters. *Sociology of Education, 76*(1), 53-70.

Kowal, J. M. & Arkin, M. D. (2005). *School restructuring options under no child left behind: What works when? Contracting with external education management providers.* Naperville, IL: Learning Point Associates.

Knudsen, E. L., Heckman, J. L., Cameron, J. L., & Shonkoff, J. P. (2006). Economic, neurobiological, and behavioral perspectives on building America's future workforce. Retrieved from http://www.pnas.org/content/103/27/10155.full.pdf.

Kozol, J. (1991). *Savage inequalities*. New York: Crown Publishers, Inc.

Ladson-Billings, G. (1994). *The dreamkeepers: Successful teachers of African American children.* San Francisco: Jossey-Bass.

Lankford, H., Loeb, S., & Wyckoff, J. (2002). Teacher sorting and the plight of urban schools: A descriptive analysis. *Educational Evaluation and Policy Analysis, 24*(1), 37-62.

Lareau, A. (2004). *Unequal childhoods: Class, race, and family life*. Berkeley, CA: University of California.

Lareau, A. & McNamara-Horvat, E. (1999). Moments of social inclusion and exclusion race, class, and cultural capital in family-school relationships. *Sociology of Education, 72*(1), 37-53.

Lasley II, T. J., Siedentop, D., & Yinger, R. (2006). A systemic approach to enhancing teacher quality: The Ohio model. *Journal of Teacher Education 57*(1), 13-21.

Lee, J. (2002). Racial and ethnic achievement gap trends: Reversing the progress toward equity? *Educational Researcher, 31*(1), 3-12.

Lee, V. & Burkham, D. (2002). *Inequality at the starting gate: Social background differences in achievement as children begin school.* Washington DC: Economic Policy Institute.

Lucas, S. R. (1999). *Tracking inequality. Stratification in American high schools*. New York: Teacher's College Press.

MacKinnon, D. P., Fairchild, A. J., & Fritz, M. S. (2007). Mediation analysis. *Annual Review of Psychology, 58*(1), 593 -614.

Magnuson, K. (2007). Maternal education and children's academic achievement during middle childhood. *Developmental Psychology, 43*(6), 1497-1512.

Mann, H. (1848). *Twelfth annual report of Horace Mann as Secretary of Massachusetts State Board of Education*. Boston: Directors of the Old South Work.

Mayer, S. E. (1997). *What money can't buy*. Cambridge, MA: Harvard University Press.

McCartney, K., Burchinal, M., & Bub, K. (Eds.). (2006). Best practices in quantitative methods for developmentalists. *Monographs of the Society for Research in Child Development, 71*(3) 1-172.

Mirowsky, J. & Ross, C.E. (2003). *Education, social status, and health*. New York: Aldine de Gruyter.

Murnane, R. J., Willett, J. B., Bub, K. L. & McCartney, K. (2006). Understanding trends in the black-white achievement gaps during the first years of school. Washington: Brookings-Wharton Papers on Urban Affairs.

National Center on Education Statistics, (2000). ECLS-K, base year public-use data file, kindergarten class of 1998-99: Data files and electronic code book (child, teacher, school files), and user's manual. Retrieved June 10, 2009 from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2001029rev.

National Center on Education Statistics. Table 33. Number and percentage of people in poverty, by sex, race/ethnicity, and age group: Various years, 1985 to 2002. Retrieved October 2, 2005 from http://nces.ed.gov/programs/youthindicators/Indicators.asp?PubPageNumber=33&ShowTablePage=TablesHTML/33.asp. .

NICHD Early Child Care Research Network, (2005). Duration and developmental timing of poverty and children's cognitive and social development from birth through third grade. *Child Development, 76* (4), 795-810.

No Child Left Behind Act, Public Law 110, 107th Cong., 1st session. (2001).

Nye, B., Konstantopoulos, S., & Hedges, L.V. (2004). How large are teacher effects? *Educational Evaluation and Policy Analysis, 26*(3), 237-257.

Ogbu, J. U. (2003). *Black American students in an affluent suburb: A study of academic disengagement*. Mahwah, NJ: Lawrence Erlbaum Associates.

Ogbu, J. U. (1987). Variability in minority school performance: A problem in search of an explanation. *Anthropology and Education Quarterly, 18*(4), 312-324.

Ogbu, J. U. (June, 1983). Minority status and schooling in plural societies. *Comparative Education Review, 27*(2), 168-190.

Palardy, G. J. & Rumberger, R. W. (2008). Teacher effectiveness in the first grade: The importance of background qualifications, attitudes, and instructional practices for student learning. *Educational Evaluation and Policy Analysis, 30*(2), 111-140.

Pianta, R. C. & Cox, M. J., (1999). The transition to kindergarten. Baltimore, MD: Paul H. Brookes.

Pianta, R.C. & Walsh, D.J. (1996). *High-risk children in schools: Constructing sustaining relationships*. New York: Routledge.

Pulliam, J. D. & Van Patten, J. J. (1999). *History of education in America* (7th edition). Upper Saddle River, NJ: Merrill.

Raghunathan, T. E., Solenberger, P. W., & Van Hoewyk, J., (2002). IVEware: Imputation and variance estimation software user guide. Retrieved March 10, 2009 from http://www.isr.umich.edu/src/smp/ive/.

Ramey, C. T. & Ramey, S. L. (1999). Beginning school for children at risk. In R.E. Pianta, & M.J. Cox, (Eds.), *The Transition to Kindergarten*. Baltimore, MD: Paul H. Brookes Publishing.

Raudenbush, S. W. & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (second edition). Thousand Oaks, CA: Sage Publications.

Rivkin, S.G., Hanushek, E.A., & Kain, J.F. (2005). Teachers, schools, and academic achievement. *Econometrica, 73*(2), 417-458.

Rivkin, S.G., Hanushek, E.A., & Kain, J.F. (1998). Teachers, schools, and academic achievement. *National Bureau of Economic Research*, Working Paper No. 6691.

Roscigno, V. J. & Ainsworth-Darnell, J. W. (1999). Race, cultural capital, and educational resources: Persistent inequalities and achievement returns. *Sociology of Education 72*(3), 158-178.

Rothstein, R. (2004). *Class and schools: Using social, economic, and educational reform to close the black-white achievement gap*. Washington, DC: Economic Policy Institute.

Singer, J. D. (1998). Using SAS proc mixed to fit multilevel models, hierarchical models, and individual growth models. *Journal of Educational and Behavioral Statistics*, *24*(4), 323-355.

Spitser, A. (2007). School reconstitution under No Child Left Behind: Why school officials should think twice. *UCLA Law Review, 54*(5), 1-45.

Stoops, N. (2004). Educational Attainment in the United States: 2003. U.S. Bureau of the Census. Current Population Reports. Retrieved July 20, 2007 from www.census.gov/prod/2004pubs/p20-550.pdf.

Wenglinsky, H. (2000). *How teaching matters: Bringing the classroom back into discussions of teacher quality*. Retrieved November 12, 2008 from http://www.ets.org/Media/Education_Topics/pdf/teamat.pdf.

Winsler, A., Tran, H., Hartman, S. C., Madigan, A. L., Manfra, L., & Bleiker, C. (2008). School readiness gains made by ethnically diverse children in poverty attending center-based childcare and public school pre-kindergarten programs. *Early Childhood Research Quarterly*, *23*, 314-329.

Woellner, R.C. (1955). Teacher certification, supply and demand. *Review of Educational Research, 25*(3), 193 -203.

Woellner, R.C. (1949). Teacher certification. *Review of Educational Research, 19*(3), 250 -253.

Xue, Y. & Meisels, S. J. (2004). Early literacy instruction and learning in kindergarten. *American Educational Research Journal. 41*(1), 191-229.

VITA

Madlene Patience Hamilton was born in Brooklyn, NY and grew up primarily in the Houston, Texas area. She attended the Debakey High School for Health Professions in Houston, Texas. She received her Bachelor of Science degree in Child Development and Family Relationships from the University of Texas at Austin in 1997 and Masters of Arts in Education Policy from George Washington University in 2003. In August of 2005, Madlene began the Ph.D. program in Educational Administration—Policy and Planning at the University of Texas at Austin. While pursuing her doctorate, she was a National Institute of Child Health and Human Development Predoctoral Fellow (F31) through the UT-Population Research Center. Her professional work experience consists of policy research at the federal, state and local levels at think tanks in Washington, DC.

Permanent address: 12323 Silo Lane, Houston, Texas, 77071.

This manuscript was typed by the author.